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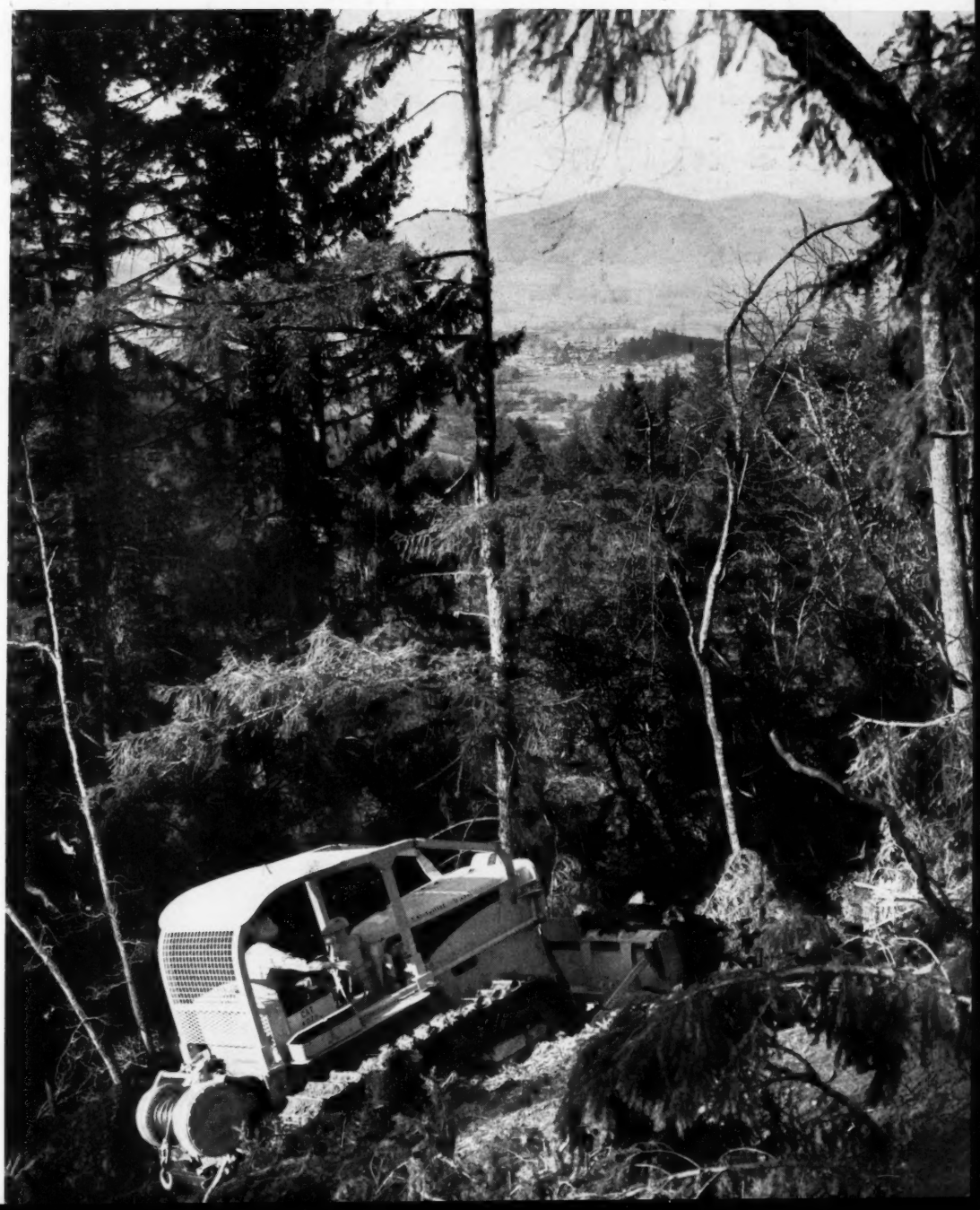

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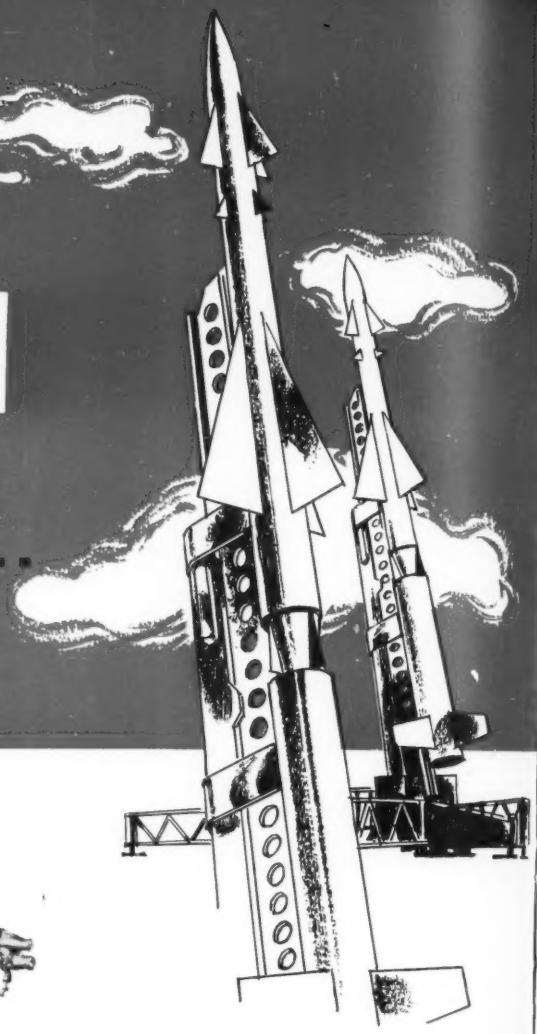

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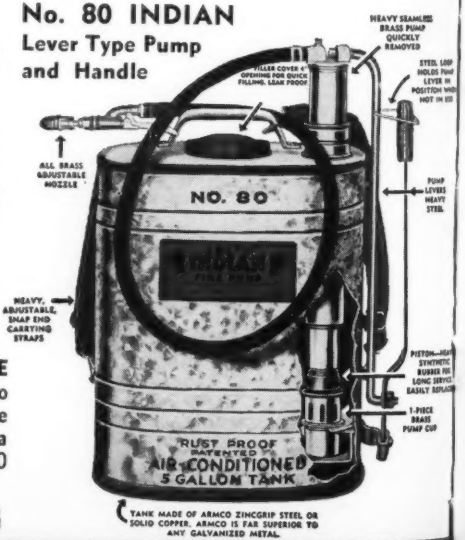
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Photo courtesy Caterpillar Tractor Co.

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Mergers in the Forest Products Industries[1]

David S. Dealey
Diamond Gardner Corporation,
Stirling City, California

DURING the past few years we have witnessed an unusual trend in the forest products industries. We have seen a large number of company mergers, far more than have occurred during any similar period in the past. This important development brings to mind certain basic questions. What is the nature and present extent of the merger movement? What are the reasons that account for the present marked tendency to merge? What effects are the mergers likely to have on the forest industries and on forest management?

Mergers in General

Before dealing with the forest products industries in particular, it will be helpful to discuss certain fundamental aspects of industrial mergers.

An industrial combination generally is one of three types (*3, 6*): (1) A vertical combination involves units which are in different stages of production; for example, a pulp mill and a paper mill. (2) A horizontal combination involves two or more units which are in the same stage of production. (3) A circular combination involves units which require similar raw materials or units whose products are marketed through the same channels.

Regardless of the type of combination which is involved, there are a number of methods of combination which may be chosen by the combining companies (*3, 6*). In a strict sense, the term "merger" applies to only one of these methods. The merger method is that where one company is absorbed by another, the absorbed company disappearing as a separate entity. In this discussion, however, the term "merger" will be used in the more general sense to refer to all industrial combinations. Another method, the consolidation, is carried out when two or more companies form a new company to succeed themselves. A sale-of-assets is the method whereby one company sells its assets to another, but remains distinct as a subsidiary. A modification of this method is the lease-of-assets. The holding company method involves one company acquiring part or all of the stock of another company, the latter remaining distinct as a subsidiary.

Obviously, if firms merge, there are incentives for doing so (*3, 6*). In other words, it is in some cases advantageous for firms to combine rather than continue operations separately. All of the advantages of merging are directly related to increasing or stabilizing profits. The advantages may be in the form of production, distribution, or advertising economies of large scale and multiunit operations. Product diversification is frequently a reason behind mergers. In some cases mergers are aimed at gaining control of marketing outlets. Tax advantages of merged firms may be an important incentive. Finally, firms may choose mergers as a means of acquiring certain needed resources such as capital, raw materials, strategic personnel, or patents.

There are certain characteristic steps which occur in the course of transacting a merger (*6*). A firm which is interested in merging can prepare in certain ways in order to be in the best possible position should a potential merger arise. For example, it is important to build a strong financial position and secure good banking connections. It may be advantageous to rearrange the control of ownership, and building a strong management organization is very important. Finally, the firm may improve its merging possibilities by improving its position in the industry.

Negotiation of a potential merger may be initiated by the executives of the business, by professional promoters, or by investment bankers. The negotiation is then continued by the directors of the involved firms who must determine the economic feasibility of the merger. The acquiring firm may make use of options while it makes the necessary investigations. First, the total value of the company being acquired must be agreed upon in order to determine the price to be paid. If a sale-of-assets is involved, the source of the capital necessary to finance the transaction must be determined. If the acquiring company gives stock in exchange for the stock of the company being acquired, the rate of exchange must be decided.

If the proposed merger survives all the preliminaries, it is drafted into a formal agreement. From a legal standpoint it must be determined that the terms of the agreement are consistent with federal and state laws and the charters of involved corporations. Final approval of the agreement must be

[1]Submitted in partial satisfaction of the requirements for the degree, Master of Forestry, University of California, May 1957.

This study was begun as a term paper for the general forestry seminar in the fall semester of 1956. Dr. Henry J. Vaux, who was in charge of the seminar, made a number of valuable suggestions for revising and supplementing the paper. Also Dr. Percy M. Barr and Mr. Dale O. Hall reviewed the original draft and offered helpful criticism.

made by the stockholders or owners of both companies.

Throughout much of the industrial era in this country, the merger situation has been affected by important legislation. This legislation has been intended to discourage socially undesirable mergers. The Sherman Anti-Trust Act of 1890 prohibited business combinations which were formed with the intent of monopolizing or restraining trade. The Clayton Anti-Trust Act of 1914 was a series of amendments to the Sherman Act which, in effect, based the application of anti-trust legislation on the actual effects rather than the intent of a business combination. The Federal Trade Commission Act of 1914 set up the bureau which is responsible for the regulation of corporations engaged in interstate commerce. In 1950 the Clayton Act was amended in order to remove certain loopholes which had long been a means of avoiding the provisions of the original act. Of course, the most important consideration is not the legislation itself, but rather the way it is interpreted by the courts. Court decisions at present are based on whether or not a merger engages in unreasonable restraint of trade through practices which would prevent another concern from carrying on, provided it operated with the same efficiency as the combined concern (*6*).

Industrial development in the United States has been marked by four important merger movements (*12*). The first movement, which occurred between 1890 and 1904, was motivated by advances in mass production and the subsequent drive for market control. Many of the present oligopolies were formed during that movement. The second movement, during the speculative period of the 1920's was inspired largely by promoters and financiers. The third movement, which was much less distinct than the others, took place in the late 1930's. It was activated principally by the desire for marketing outlets and distribution economies. The most recent period of mergers has been occurring since the end of World War II (*4, 14*). Immediately following the war, the movement was encouraged by the accumulation of large wartime working capital, by the unbalanced activities of many companies, and by the desire to achieve a strong strategic position before the return to a buyers' market. However, the merger activity did not stop after the immediate post-war surge. Instead, the movement has become even more vigorous during the 1950's. One of the major forces which has given added encouragement to the wave of mergers has been the current technological and financial disadvantages of small firms (*8*). As a result some of the small firms have joined to become bigger, and many small firms have been absorbed by opportunistic large firms. This most recent merger movement reached what appeared to be a peak year during 1956. The specific merger activity with which we are concerned, that which has occurred in the forest products industries, has been strong during the last few years of this general merger movement.

Organization of the Forest Industries

The three most important forest products industries—lumber, pulp and paper, and plywood are the ones which have been involved in most of the recent merger activity.

The lumber industry in the United States is characterized by a very large number of producing units. The number of sawmills fluctuates around 50,000, depending on market conditions (*7*). There is great variation in the size of producing units, as shown by the fact that 3 percent of the mills produce 57 percent of the lumber (*2*). Although some companies own a number of producing units, the degree of concentration of ownership in the lumber industry is lower than in nearly any other industry. In 1947 the largest company accounted for less than 5 percent of the total domestic lumber production; the four largest companies produced less than 6 percent; and the 50 largest produced less than 18 percent (*11*). The largest retail lumber distributor accounted for less than 2 percent of the lumber distribution (*5*).

The organization of the U. S. pulp and paper industry is quite different. There are a relatively small number of producing units—approximately 1,000. There are between 500 and 600 operating companies (*10*). The 1947 production figures show that the four largest paper and paperboard companies produced over 15 percent of the domestic total and the 50 largest produced over 56 percent (*11*). Pulp production was somewhat more concentrated, with the output of the four largest companies being over 27 percent of the total and that of the 50 largest being over 85 percent. Thus the degree of concentration is much higher in the pulp and paper industry than in the lumber industry, but still it is lower than in many industries.

The veneer and plywood industry is somewhat similar in organization to pulp and paper. The ownership structure, although highly concentrated in comparison to the lumber industry, is considered relatively unconcentrated among all industries. In the softwood plywood industry, which accounts for two-thirds of the peeler consumption of the veneer and plywood industry as a whole, the two largest firms produce over 10 percent of the current total output (*9*). However, these same two firms account for a considerably larger percentage of the wholesale distribution of softwood plywood. The four largest firms presently account for less than 20 percent of the industry's output, with the remainder divided among a fairly large number of medium and small-sized firms.

Although the means of expansion of forest products companies prior to 1955 varied greatly between individual firms, mergers were more predominant in the growth of the larger pulp and paper and plywood companies than in the growth of lumber companies. In the lumber industry, internal growth has been far more important than growth by external combination.

Nature of the Current Movement

Although it is difficult to obtain complete data on the merger situation in the forest industries prior to and since the beginning of the assumed merger movement, a few generalizations can be made concerning the nature of the movement. The mergers in the pulp and paper industry have received more national attention than have the other forest industry mergers. This industry has been cited by the Federal Trade Commission (*13*: Feb. 7, 1955) as being one of the seven industries in which merger activity has been the strongest during recent years. F.T.C. studies show 52 mergers in the "paper and allied products" industry in 1955 and 1956 as compared with 60 mergers in this industry during the 7 year period from 1948 through 1954 (*13*: May 23, 1955; Feb. 18, 1957). However, there has nearly always been a certain amount of merger activity in the pulp and paper and plywood industries. Thus the recent mergers within these industries, while being very significant with respect to number, are not as unusual in nature as the many mergers within the lumber industry and those between lumber companies and companies which were formerly not lumber producers.

It is difficult to say just when the merger movement in the forest industries actually began. In 1953 a fairly large number of mergers occurred in the forest industries, but only a few of them involved large companies. In 1954 more of the relatively large companies took part in mergers. The years 1955 and 1956 can probably be considered the peak years in merger activity thus far. During these two years there were a large number of forest products industry mergers, many of them involving relatively large firms (*1*). Thus the relative size of merging firms is a significant factor in the movement.

Reasons Behind the Mergers

In order for a merger to be worked out, it must, of course, be favorable to both of the companies involved. Except in the case of a consolidation (the method of combination where two companies form a completely new company) the two parties involved in the combination can be distinguished as the buying or surviving company and the company which is acquired or bought out. These two companies will have very different reasons for deciding to enter the merger.

The motivations of the companies which have been acquired are quite difficult to investigate. When a merger is publicized, the reasons given are usually those of the acquiring company. However, there are a few factors that appear to be the most important among the many which probably influence companies to sell out. Often it is a combination of reasons rather than just one.

One of the most evident reasons is a shortage of timber supply. If a company is in such a position that it does not have sufficient timber of its own to continue operations and is not able to compete successfully for other timber, it must close its plant or sell it to a company which has available timber. Usually the small, inefficient operations which are not able to successfully compete, for reasons other than timber shortage, will go out of business rather than merge.

Investment considerations may influence the selling company. If the company anticipates a decrease in the value of its assets, it may be advantageous to sell. If the owner or owners have actively participated in the management of the firm, selling the firm may be the only way in which they can convert their efforts to money. Also they may wish to liquidate their capital in order to invest it elsewhere.

The state of ownership of a company may be inadequate for future business operations. The best example of such a situation is where all the owners are very old and the future of the ownership is, therefore, uncertain.

Taxes of all kinds—income, capital gains, estate, and property—play a very important role in the financial aspects of all business activities. Thus it is not illogical to assume that tax savings have been an important consideration in many of the mergers. For example, the selling company is able to take advantage of the capital gains tax rate, which is particularly attractive during the current period of high corporate income tax rates.

The motivations of the acquiring companies are related to their desire to improve their competitive position. Here timber supply again comes into the picture. Through recent changes of ownership a number of companies have acquired or consolidated timber holdings in order to meet the increasing competition for timber and avoid higher stumpage prices. These efforts toward building up large holdings of timberland are another indication of the trend toward permanency of operations.

Another important factor in many of the mergers is the desire to integrate manufacturing facilities in order to realize better returns from high value logs. Production and administrative economies effected by large scale operations are apparent aims of many of the recent mergers. Taxation advantages also figure highly among the reasons of the acquiring companies.

Most of the mergers which have occurred have probably been motivated by a combination of factors. Some of these factors have been mentioned and others undoubtedly exist, but are less obvious. The ever-present desire to get bigger is a strong underlying cause in most mergers.

It has been shown why it is often advantageous for a firm to expand its operations. But why would a firm prefer merging to internal growth as a means of expansion? One obvious advantage of merging is that it is faster, and speed is important in our fast-moving industrial economy. Also, merging may require less capital investment to gain the same results, particularly during periods of high construction costs (*8*). Buying a going business rather than building a new one usually reduces the

uncertainty of the investment. In a corporation, the exchange of stock which occurs in a merger may be more feasible financially than selling new stock to provide money for building. Finally, merging avoids the early competition of establishing facilities in a new area or producing new products.

Timing and the factors which change with time have a strong influence on merger activity. Some of these factors have been mentioned previously but should be emphasized. Probably the most important of these factors are (1) the present trend toward permanent operations, (2) the boom in demand for wood products which occurred in the early 1950's, (3) the recent increase in competition for stumpage and high stumpage prices, (4) the availability of sufficient investment capital when it was needed, (5) the current financial and technological disadvantages of small firms in general, and (6) a political climate which is relatively favorable for big business.

Effects on the Forest Industries

The discussion of forest industry mergers has thus far been focused on the past. The next questions to be considered are concerned with the future of the forest industries and forest management as affected by the merger movement.

The economy of the forest industries is likely to be affected in several ways.

The economies of scale which are brought about by mergers have been discussed. Possibly these savings will help to check the trend of rising costs of production. Even though costs will probably continue to rise, the production costs of recently merged firms may not rise at the rapid rate which they have in the past. As a result, prices of forest products may not continue to rise as rapidly relatively to the prices of competing products.

Supply of forest products may be slightly affected by the mergers which have blocked up timber holdings. This is due to the fact that the amount of stumpage formerly available to small operators has been reduced.

A merger movement in any industry always raises the question of whether there has been an increase in the concentration of economic power (*14*). In the lumber industry, with its large number of producing units, there probably has not been any significant change in the absolute concentration (the proportion of the entire industry owned by the largest firms). However, since most of the mergers were between previously large firms, there may have been a slight increase in the relative concentration of economic power. The relative concentration is the output of the large firms in the industry relative to the output of the smaller firms. This change, however, is not likely to result in increased price control by large firms.

In the pulp and paper and plywood industries the number of firms which existed prior to the merger movement was much lower than in the lumber industry. Therefore, the increase in concentration of economic power in these industries has probably been more significant.

The concentration of timber ownership may tend to remove some of the competition in the forest industries.

The economy of the forest industries has been greatly stimulated by the recent developments in integrated utilization of wood resources. These developments have been accentuated by the numerous inter-industry mergers. Another form of integration which has resulted from some of the mergers is vertical integration. Companies have spread their operations into new stages of production. The most important vertical acquisitions have probably been timberland acquisitions by companies which formerly purchased their timber as stumpage or logs.

The management of the acquiring firms face certain new problems as a result of the mergers. The most difficult problem is that of organization. The various operations and the top personnel must be organized in the manner which is most advantageous to the company as a whole. Financial and administrative details must be worked out. It is very important that the change of ownership and reorganizations be carried out without damaging employee morale.

Some of the mergers will probably have significant effects on the forest communities. The economy of the forest communities will definitely be benefited to the extent that permanence of operations results from the mergers. In the communities which can look forward to a sustained future existence, living conditions improve, populations become stabilized, and local businesses benefit.

The activities of large firms are closely watched by the public. Public opinion sometimes does not favor large enterprise or the moves that tend to make companies bigger. However, in view of the good effects of the forest industry mergers it is not likely that most of the mergers will receive much public criticism. Actually the mergers provide an excellent opportunity for increased public relations efforts by the firms involved.

Closely connected with public opinion are the legal effects of the mergers. Several of the recent acquisitions have been charged by the Federal Trade Commission as being violations of the Clayton Anti-Trust Act. The mergers which have been charged are the Crown Zellerbach Corporation acquisition of St. Helens Pulp and Paper Company (*13*: Mar. 8, 1954; May 23, 1955; Mar. 7, 1957); the Union Bag and Paper Corporation purchase of stock of Hankins Container Company (*13*: July 18, 1955; May 28, 1956); the Scott Paper acquisitions of Soundview Pulp Company, Detroit Sulphite Pulp and Paper Company, and Hollingsworth and Whitney Company (*13*: June 8, 1956; Nov. 12, 1956); and the International Paper Company acquisition of Long-Bell Lumber Company (*13*: Nov. 12, 1956).

Effects on Forest Management

In addition to the general effects which the mergers will have on the forest industries, there will be important effects on the practice of industrial forest management. The major function of industrial foresters is to provide the needed raw materials to the industry. The companies that have acquired more timberland have given their foresters a better source from which to obtain the required resources. The acquisition of timberland helps to alleviate the problem of supplying timber to meet present plant capacities. In addition it provides a better opportunity for building a sustained timber supply.

The large, blocked-up forest properties provide greater possibilities for intensive forest management. Additional finances, personnel, and facilities which will be advantageous in industrial forest management programs have been gained by many of the acquiring firms. Expanded forestry operations of some companies may result in cost economies.

The integration of manufacturing facilities increases the proportion of the forest resources which can be economically utilized. Forest management possibilities are more flexible, because a greater diversity of size and quality classes of timber can be harvested profitably. Also a greater percentage of each tree is actually converted to useful products, thus spreading the costs of timber production over a greater quantity of end products.

The present trend in the forest products industries is toward large, integrated operations backed by large timber holdings. The merger movement has been an important part of this trend. Whether or not mergers will continue to be an important means of expansion of forest products companies is difficult to foresee. There is little doubt, however, that the mergers that have occurred will be successful as a quick means of adapting to the present economy.

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Forest Fertilizing in Britain[1]

Dr. L. Leyton
Department of Forestry
Oxford University

FORESTRY PRACTICE in Britain has been, and still is, largely concerned with afforestation. There is little doubt that some few thousand years ago the country was well covered with forest, in the South and probably also at lower altitudes in the North, predominantly with hardwoods, in the Scottish Highlands possibly with Scots pine and birch. Partly due to climatic changes but largely because of man's activities in burning, clearing and grazing, little or none of this forest has survived. On the drier eastern side of the country, on the better drained sands and glacial drifts, the destruction of the forest was followed by the invasion of an ericaceous vegetation, principally the common heather, *Calluna vulgaris;* under this heath vegetation extensive podzolization has occurred resulting in a considerable degradation in fertility. Probably Scots pine and birch would ultimately colonize these heaths but have been prevented from doing so by grazing and periodic burning. In the wetter more mountainous regions of the West and North a peat forming vegetation predominates, the dominant species, Sphagnum, Scirpus, Eriophorum, or Molinia, being determined by geology and topography; in certain areas peat has accumulated to depths of more than twenty feet.

These areas, of a type more or less unique to Northwest Europe and occupying about 10 percent of the total area of England and Wales and over 50 percent of that of Scotland, present a particular challenge to the forester. Nevertheless, whereas some thirty years ago all but the most fertile marginal sites were considered unplantable, today, advances in planting techniques, in cultivation, and in the choice of species have rendered most at least potentially afforestable. In most cases and particularly so on the poorest peats, the chances of successful establishment have been considerably improved by the application of fertilizers, especially phosphate, at the time of planting. This has now become established practice but behind it lies the experience of hundreds of trials carried out by the Research Branch of the Forestry Commission, mainly on the peats, into the effects of different types of fertilizer, different methods of application and different species. The history and results of these trials are briefly summed up below.

Phosphatic Fertilizers

Though the first recorded use of phosphate (as basic slag) in the establishment of a tree crop in Britain dates back to 1907, the potentialities of this fertilizer were not fully appreciated until 1925 when some stimulation to the growth of Sitka spruce was observed on one of the most intractable Scirpus peats in the country, the Lon Mor in Scotland. The results of further trials proved so promising (Figs. 1 and 2) that, by 1928, the application of phosphate had been introduced into standard practice, and, with relatively few modifications, has remained so to the present day. Most of the earlier peat trials were based on the species, Scots, mountain, and Corsican pine, Norway and Sitka spruce, and hybrid and Japanese larch, these being the only ones which experience had proved to be at all possible on such sites even though, in many cases, growth was very poor. To a greater or lesser extent, depending on site type, all species have shown some response to phosphate; the least demanding species, the pines, show less response than the more demanding spruces and larches for the successful establishment of which on the poorest peats, phosphate has proved

[1]The author gratefully aknowledges the cooperation of H. M. Forestry Commission, not only for allowing publication of their results and experiences, but also for providing the illustrations and permission to reproduce them.

M. Nimmo, 1938, H. M. Forestry Commission.

FIG. 1.—Sitka spruce. With basic slag on left, controls on right. Rod, 6 ft. Expt. 7. P 28 Beddgelert, N. Wales. Age, 10 years from planting.

essential. Even with the pines however, growth on these sites has often been doubled or trebled (Table 1). On the better sites, of course, the response to phosphate is correspondingly less.

Numerous experiments have been made to compare different fertilizers and different rates of application. In earlier years basic slag was the principal source of phosphate, but this proved to be of variable quality and since ground mineral phosphate was shown to be at least as effective as high quality slag, this has now largely replaced the slag. Early trials with the more soluble superphosphates gave high losses and though these were probably due to faulty placement (i.e. in direct contact with the roots), they have still to find common use, at least on the peats. On the heaths, on the other hand, recent trials have suggested some superiority of superphosphates and since, in terms of P content, their weight is considerably less than that of mineral phosphates, more attention is now being paid to this fertilizer. Experiments on different rates of application have shown that although small quantities (of the order of 1/8th ounce per plant) would generally ensure survival, even on the poorer peats, the response of growth generally increased with increasing dosage up to about 4 oz. per plant; beyond 2 oz. however (about 2½ cwt.[2] per acre), the extra gain seldom justifies a higher rate of application and this more or less represents the generally accepted level. Occasional experiments with exceptionally heavy dosages, of the order of 1½ lbs. per plant, have shown some extra benefit with certain species on certain sites, e.g. on soils derived from Serpentine, but the cost of such amendments is prohibitive except perhaps in special cases of salvage. In the earliest trials the fertilizer was laboriously mixed with the mineral soil before application; subsequent trials have shown that the simpler and less expensive top dressing was at least comparable and this method is now standard practice. The time of application appears to be of some importance; if fertilizing is delayed for more than a year or two, its effect is often reduced, but since the cost amounts only to from 5 to 10 percent of the total cost of establishment, fertilizing is often carried out even where no prior evidence of its necessity is available.

[2]The British hundredweight equals 112 pounds.

M. V. Laurie, 1953, H. M. Forestry Commission.

FIG. 2.—Scots pine on Scirpus/Molinia peat. With basic slag on left, controls on right. Expt. 19. P 26 Lon Mor, Scotland. Age 27 years from planting.

Nitrogenous Fertilizers

Though generally speaking, the application of nitrogenous fertilizers (e.g. ammonium sulphate, nitro-chalk[3]) at the time of planting has proved to be of little benefit on the peats, on the heaths evidence is accumulating that some years after establishment, growth in many cases may be seriously limited by nitrogen deficiency; recent trials on such sites have disclosed appreciable responses in growth to nitrogenous fertilizers. With inorganic sources of nitrogen however, the effect is frequently short lived and some attention is being paid to the use of slower acting organic sources such as formalized casein waste.

[3]Nitro chalk is a granulated mixture of ammonium nitrate and calcium carbonate containing 15 percent N and 48 percent $CaCo_3$.

Potassium Fertilizers

From the few trials which have been made, it would seem that on the peats at least, potash applied at the time of planting has little effect. On certain heaths, however, occasional promising responses have been obtained and further more intensive trials with this fertilizer are now being laid down.

Lime

Considering the very great benefits of liming which have been reported from other European countries, surprisingly few trials have been carried out in Britain, and on the peats at least, the results have been inconclusive. In recent years, however, with the increasing number of established but poorly growing stands on the heaths, more interest has been shown in this treatment.

TABLE 1.—THE RESPONSE OF DIFFERENT SPECIES TO PHOSPHATE (ACHNASHELLACH, SCOTLAND)

	Dominant heights (to nearest foot) at 23 years	
Species	Controls	Basic slag @ 3 oz./plant
Mountain pine (*Pinus mugo*)	9	12
Scots pine (*P. sylvestris*)	6	13
Lodgepole pine (*P. contorta*)	11	22
Sitka spruce (*Picea sitchensis*)	Failed	7·8
Japanese larch (*Larix leptolepis*)	18	37

Magnesium Fertilizers

Occasional trials with magnesium sulphate at ½ oz. per plant, in combination with other fertilizers, have shown little benefit on the peats and little further interest has been taken in this nutrient.

Micronutrients or Trace Elements

Occasional trials with the elements boron, copper, and manganese, have generally proved inconclusive though very recently a case of copper deficiency in Sitka spruce seedlings has been reported from a heathland nursery in Southern England. Though no doubt this finding will stimulate further interest in micronutrients, there is as yet no evidence of an organized research program.

Fertilizing After Establishment

Since, in the past, afforestation has been one of the major concerns of British forest policy, it is perhaps understandable why all but a few fertilizer experiments have been directed towards establishment. Now that a large number of the earlier plantations have reached at least the canopy stage, some of them showing very unsatisfactory growth, more attention is being paid to the value of fertilizers as a means of increasing yield. In some instances repeated applications of phosphate have given a further stimulus, in others, this treatment has had little or no effect. In certain heathland plantations, where phosphate had proved beneficial at the time of planting, only nitrogen was later found to promote growth; evidently conditions may change as the stand matures. Besides these problems, however, there still remains the legacy of numerous checked or semi-checked plantations, especially of Sitka spruce on heathland sites, representative of earlier plantings, which may require very special treatment if they are to be salvaged. Allied to this is the problem of mixed spruce-pine plantations in which the nurse species, the pines, have so outgrown the spruce that the latter are in danger of complete suppression; in this case the possibility of differential fertilizing merits some attention.

The Use of Fertilizers in the Nursery

Current nursery practice in Britain makes considerable use of fertilizers. Early trials with organic composts in heathland nurseries, and the successful establishment of transplants raised in this way on difficult sites had originally led to the belief that composts were essential for the production of suitable planting stock; more recent trials, however, have shown that stock raised on purely inorganic fertilizers was in no way inferior to that raised on compost and that subsequent growth in the field was at least comparable. As a result of this experience official policy has now gone over almost exclusively to the use of inorganics in certain nurseries (so called agricultural, with a relatively high soil nutrient content and pH greater than 5) but, mainly for reasons of caution, would still recommend a combination of compost and inorganic fertilizer for heathland nurseries (light soils with a relatively low nutrient content and pH less than 5). Normally a complete NPK treatment is applied; the P and K are conventionally applied in early spring as granular potassic superphosphate (13 percent P_2O_5, 13 percent K_2O at the rate of 6 cwt. per acre and cultivated into the top 2-3 inches of the soil. In heathland nurseries, nitrogen is applied as a top dressing, in the form of nitro-chalk, (15.5 percent N), at about 26 cwt. per acre, in mid June and again in mid July; in nurseries on agricultural soils this is replaced by ammonium sulphate at 1.7 cwt. per acre. The above measures have proved suitable for raising 1/1 stock of the spruces, pines, Tsuga, Thuya, and Abies, but in the cases of larch and Douglas-fir, may lead to excessive growth and failure to harden off in the winter. In such cases the nitrogen top dressings and the initial compost treatment, where applied, are reduced.

Summary and Conclusions

It is evident even from the above brief summary that the actual and potential benefits of fertilizing in forestry practice have long been appreciated in Britain though it must be admitted that the urgent need for home grown timber has undoubtedly encouraged the intensive nature of the measures adopted in raising this timber. Preoccupation with the establishment problem, especially on infertile peat and heath sites, has naturally restricted most trials to the nursery and planting stages, and in the latter case the application of phosphate has gone into established practice. With the rapidly increasing growing stock, much of it unfortunately of relatively low yield, interest has been further stimulated in the direction of increasing this yield and there would seem to be little doubt that the next few years will see a rapid extension of this approach.

Sequential Sampling in Reproduction Surveys[1]

J. H. G. Smith and J. W. Ker[2]

SEQUENTIAL SAMPLING, in which the number of samples required is determined as the sampling progresses, is a very economical method of sampling. In fact, development of the concept by Dr. Wald was considered so important by the United States Government that its publication was withheld until the end of World War II (*3*). Although sequential sampling seldom has been applied to forestry problems, Stark (*7*) and Ives (*5*) have described its use in forest entomology. This note will show that sequential sampling also is useful in surveys of land that can be pre-stratified into several classes of reproduction.

In a recent survey of reproduction on part of the University Research Forest at Haney, pre-stratification was possible. Aerial photos of areas logged before 1930 were used for control of inventory, for mapping, and for stratification into good, medium, and poor stocking classes. The plantable portions of poorly stocked areas were classified further in terms of species and amount of ground cover, access, and slope.

On other lands where it is necessary or desirable to defend the classification of an area as either well or poorly stocked for purposes of taxation or administration, the use of a sequential sampling scheme would be convenient. Generally, it is reasonable to assume that, as at Haney, the extremes of stocking can be recognized easily and need only be confirmed by suitable spot-checking of the original classification. Most difficulties arise in the borderline cases between poor and medium stocking and where the occurrence of reproduction is very spotty.

Required Data

The number of plots required to classify an area as "stocked" or "non-stocked" depends upon the distribution of trees on the area, the degree of stocking required, the confidence level desired for the estimate, and the actual progress of sampling. If the area in question can be pre-stratified accurately, each type can be sampled most conveniently with a line of 4-milacre plots. Each plot should be broken into four 1-milacre quadrats and the number of those that are stocked should be plotted cumulatively over the cumulated number of 4-milacre plots. Examples of sampling charts are given in Figures 1 and 2. The

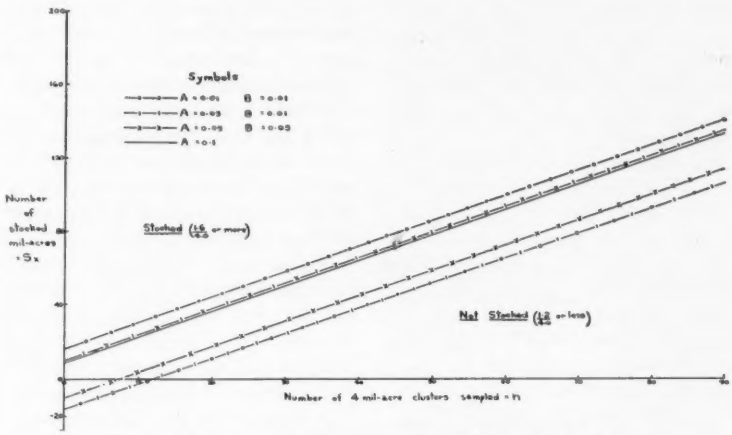

FIG. 1.—Sequential sampling chart for Poisson distribution.

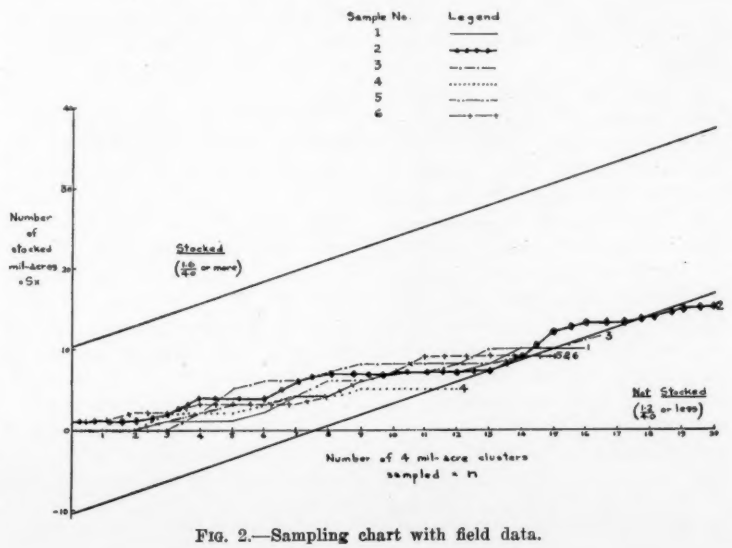

FIG. 2.—Sampling chart with field data.

[1]Research Note No. 17, Faculty of Forestry, The University of British Columbia. Funds from a University Research grant made this study possible. The assistance of R. M. Newnham and advice of Dr. S. Nash are gratefully acknowledged.

[2]Respectively assistant and associate professor, Faculty of Forestry, University of British Columbia, Vancouver.

TABLE 1.—TESTS OF THE DISTRIBUTION OF MILACRES BY STOCKING CLASSES

Stocking class	No. of strips	Mean (Stocked quadrats)	Variance	Chi-square for distributions			
				Poisson	Normal	Binomial	Neg. binomial
Percent							
1-10	1	0.4	0.27	1.34	0.08	0.97	
11-20	4	0.7	0.96	0.22	10.17	0.79	0.39
21-30	8	1.1	0.98	0.08	0.73	0.31	
31-40	9	1.5	0.87	0.36	2.99	1.66	
41-50	8	1.9	1.45	0.60	0.50	2.70	
51-60	11	2.2	1.59	1.69	1.19	2.59	
61-70	11	2.6	1.29	0.31	0.76	1.22	
71-80	15	3.1	0.87	0.08	0.91	0.22	
81-90	5	3.5	0.70	0.75	4.76	2.12	
91-100	10	3.9	0.15	0	2.18	.01	

required calculations will be described later.

If the plotted points reach a predetermined upper-level line on a graph such as Figure 1, the type is designated "stocked" and sampling can cease. Similarly, in a poorly stocked area the type is called "non-stocked" when the plotted points reach a lower-level line on the graph. The spacing that may be allowed between 4-milacre plots on the sampling line can be varied according to the size of the type. It might range from 0.2 to 2.0 chains and should be specified in a working plan along with conventions such as the direction of the sampling line. A very effective sampling line is one traversing the longest diagonal of a type, with spacing between plots set by dividing the length of the diagonal by twice the calculated average number of samples required to reach a decision. Once a decision has been reached, tallying can stop unless a non-mapped type change becomes evident.

In order to develop an appropriate sequential sampling scheme it is necessary to know the distribution involved (*6*). Data in Table 1 from the University Forest indicate that the most representative distribution for 1-milacre quadrats in clusters of four is the Poisson. Eighty-two strips each containing 10 clusters of four 1-milacre quadrats established at intervals of 1 chain were studied. The variance of stocked 1-milacre quadrats increased directly from 0.5 at 10 percent stocking to 1.5 at 50 percent and decreased again directly to 0.5 at 90 percent stocking. This suggests the advantages of expressing stocking above 50 percent as (100 percent stocking). Strips were sorted by stocking classes and for each class the applicability of Normal, Poisson, Binomial, and Negative Binomial distributions was tested. Grouped Chi-squares were calculated to test the fit of each distribution. Since the least Chi-square is indicative of the best fit for each class in Table 1, either the Poisson or Binomial distributions could be used to represent these data. The Negative Binomial is applicable in those very few cases where the variance is larger than the mean.

Measures of "adequate" stocking were selected by Allen, Griffith and Ker (*1*) and Dembicki (*2*) as 40 percent by milacres or 70 percent by 4-milacre plots. This and the estimate of minimum stocking suggested by the B. C. Forest Service, 30 percent by milacres, can be used in establishing upper and lower limits in a sequential sampling plan. Other suitable standards could be set to serve a particular case.

The risk of calling adequate stocking "poor" should be set ordinarily at p=0.05 and that of calling poor stocking "adequate" at p=0.01. When such standards were used on a test area of poor stocking, 16 strips were classed as "not stocked" with an average tally of 18 plots, each containing 4 milacres. The range in number of plots required in order to reach a decision was from 10 to 55 plots. The number of samples is reduced slightly by increasing "p" values, but savings from this source should be small.

It might be desirable to recognize a "medium" stocking class lying between 30 and 40 percent stocking by milacres. However, such a refinement would greatly increase the cost of the survey.

Field Trails

Figure 2 represents a sampling chart with actual field data. Both upper and lower confidence limits were set at p=0.05. The data were collected on an area classed as poorly stocked in an original survey which was based on aerial photographs. This classification was confirmed by each of a series of six sampling runs. Any one of these runs could have been used to verify the typing. The type could be designated "poorly stocked" after 12, 13, 15, 15, 15, and, for line 2, either 13 or 18 plots had been assessed. The effect of clumping is evident in line 2 which was extended to show the influence of continued sampling. The average stocking was 16.3 percent by milacre quadrats on the basis of a total of 380 measured within the type.

It should be noted that, in the plan illustrated by Figure 2, eight plots in a row each containing four 1-milacre quadrats without seedlings would have to be tallied to classify the area as "not stocked." Only four fully stocked plots in succession would be needed to qualify an area as "stocked" under this sampling scheme. A further subjective classification such as "partially plantable" might be sufficient to describe a mixture of good and poor stocking, part of which should be planted.

Calculations Required

Calculations used in developing Figures 1 and 2 have been based on information secured from Dr. G. B. Oakland of Science Service at Ottawa. The following calculations were required to prepare Figure 1. Further details may be obtained from texts, e.g. Wald (*8*), Duncan (*3*), and Goulden (*4*).

Since the Poisson distribution may be used as the model, the general formulae for the average numbers of samples required are:

$$\bar{n}_{m1}=\frac{(1-A)\,b-Aa}{(m_2-m_1)-m_1 log_e \frac{m_2}{m_1}},$$

and $$\bar{n}_{m2}=\frac{(1-B)\,a-Bb}{m_2 log_e \frac{m_2}{m_1}-(m_2-m_1)}.$$

In applying these formulae to the example, m_1 equals the smaller average which is 30 percent stocking by milacres or 1.2 stocked in each cluster of four. The larger average, m_2, represents 40 percent stocking by milacres or 1.6 quadrats stocked in each cluster of four. A is the risk of describing adequate stocking as poor stocking which we have set at p=0.05. B is the risk of describing poor stocking as adequate; and since this error would be more harmful than the "A" risk, it has been set at p=0.01. Natural logarithms must be used; therefore the abbreviation "log_e" is entered where required. The terms "a" and "b" are dependent upon the confidence level required in the classification and are calculated from:

$$a=log_e \frac{1-B}{A} \text{ and } b=log_e \frac{1-A}{B}.$$

An observation on the variable, i.e. the number of quadrats stocked, is x, and Sx is the sum of all the x's for n observation samples. These are used in calculating the lines of the sampling plan which are defined as:

$$Sx = -h_1 + sn \quad \text{and} \quad Sx = h_2 + sn$$

where: $$h_1 = \frac{b}{log_e \frac{m_2}{m_1}}, \qquad h_2 = \frac{a}{log_e \frac{m_2}{m_1}}, \qquad \text{and} \qquad s = \frac{m_2 - m_1}{log_e \frac{m_2}{m_1}}.$$

Using the formulae and assumptions just stated, we get $a = 2.986$ and $b = 4.554$ with $\bar{n}_{m1} = 80.0$, $\bar{n}_{m2} = 48.3$, $h_1 = 15.8$, $h_2 = 10.4$, and $s = 1.39$. Then the lower line of the samping plan is Sx = -15.8 + 1.39n and the upper line is Sx = 10.4 + 1.39n. Changing the confidence required to $A = 0.1$ and $B = 0.05$ would reduce the average sampling numbers required to cross upper and lower lines to 40 and 31, respectively. The levels of confidence required probably should not be reduced below these points.

In using a graph such as Figure 1, it is quite likely that in some cases sampling could continue long past the average sample number without reaching a decision. Some convenient level such as twice the average sampling number should be accepted as the point at which sampling could be stopped and the type classed as "medium" in stocking. Alternatively, the average of the tallied samples may be determined for comparisons with the averages required for designation of the type as "stocked" or "not stocked." If a "medium" class is not desired, the type would be assigned the classification to which the calculated mean conforms most closely.

Conclusion

In conclusion it should be evident that, where pre-stratification is possible, sequential sampling schemes can result in considerable savings in the field work required in reproduction surveys. The calculations required in developing sequential analyses will also prove to be useful in evaluating the confidence that can be attached to data on reproduction secured by conventional sampling techniques.

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North American Wildlife Conference

The 23rd North American Wildlife Conference will be held March 3-5 in the Sheraton-Jefferson Hotel, St. Louis, Missouri.

A Dwarf Form of Eastern White Pine (Pinus strobus L.)[1]

Henry H. Chisman and Nicholas Lylo

Respectively, associate professor and graduate student, School of Forestry, Pennsylvania State University

MOST FOREST TREE species will occasionally produce dwarf forms along with normal progeny. Hornibrook (*3*) explains this by saying, "As from a normal human being a Tom Thumb sometimes appears, so in trees a dwarf appears." The extent of these abnormal forms is indicated by the appearance of such varietal names as *prostrata, globosa, pygmaea,* etc., in plant manuals. However, it appears that the dwarf habit is more prevalent in some tree species than in others. Hornibrook (*3*), for example, lists 60 dwarf forms of *Picea excelsa* Link., 14 of *Juniperus chinensis* L., 8 of *Pinus strobus* L., but only one of *Pinus resinosa* Ait.

The segregation and propagation of dwarf forms of conifers have received special attention in European and Asiatic countries. In fact, many of the dwarf varieties have been described from specimens in European nurseries. The seedbeds are examined for abnormal tree forms and when such a form is found it is transplanted and receives intensive cultivation. Therefore, it is not surprising that little is known of the parentage of these dwarf specimens or the frequency of their occurrence. Furthermore, in some cases the same form has been assigned several varietal names by different writers.

An opportunity to observe the origin, development, and frequency of occurrence of dwarfism in eastern white pine (*Pinus strobus* L.) came about with the discovery of a number of dwarf specimens on the farm woodlands of The Pennsylvania State University. (Fig. 1) These specimens are located on the fields of an abandoned farm that were planted in 1939 with various species of coniferous and hardwood trees. Since game management was one of the objectives of the planting, the species were arranged in blocks, separated from each other by unplanted strips varying from 66 to 150 feet in width. The dwarf white pine trees have been found within the planted blocks as well as on the unplanted strips.

In order to aid the game management objective, all hedgerows and large trees standing on the area at the time of planting were permitted to remain. Among these remaining trees were three large eastern white pines. Since these were the only white pine trees of seed bearing age within effective seeding range of the area it seemed probable that one or more of them produced the dwarf offspring.

Observations in the field lead to

[1]Authorized for publication on March 28, 1957, as journal No. 2142 in the journal series of the Pennsylvania Agric. Expt. Sta.

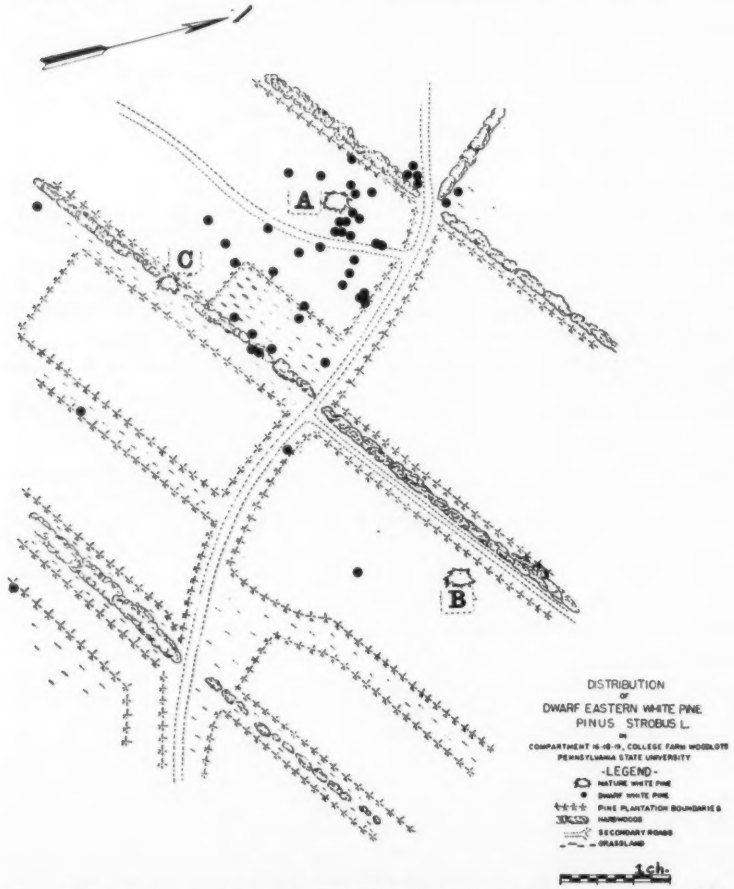

FIG. 1.—The black dots show the distribution of dwarf specimens of eastern white pine in relation to the three possible parents.

the belief that a study of the distribution of the dwarf specimens with reference to the three seed sources—tree *A*, *B*, and *C* of Figure 1—might single out the parent or parents. For this purpose a base map was prepared from existing forest maps on which the three mature white pines were located. Using each of these as an origin, quadrants were laid out on the ground with one of the axes running in a northwest-southeast direction or along the path of the prevailing winds of the region. Within each of the quadrants, all dwarf specimens were located and mapped to the extremities of the old fields. Analysis of the data showed that the largest number of dwarfs occurred in the vicinity of tree *A*. For this reason, not only were the dwarf progeny mapped in relation to this tree, but in addition all normal progeny were counted.

A total of 47 dwarf specimens was found. The location of these dwarfs with respect to the three possible parents suggests that tree *A* is the parent of the majority of the specimens. Five of these can possibly be progeny of tree *B* or tree *C*. However, since they are located well within the seed dissemination range of tree *A*, it is equally possible for them to be progeny of tree *A*.

None of the dwarf forms were found to the leeward of tree B although an abundance of normal reproduction was found in this location. This would seem to exclude tree *B* from consideration as the parent of the dwarf variety.

White pine in central Pennsylvania produced an exceptionally good seed crop in 1956. Tree *C*, however, bore no cones in the fall of this year and when the ground under the crown of this tree was examined for old cones as evidence of seed production in previous years none were found. It appears that tree *C* is a poor seed producer and therefore is probably not the parent of any of the dwarf specimens.

Considering the location of the abnormal forms in relation to the three possible parents, the direction of the prevailing winds in the region in the fall of the year and the apparent sterile character of tree *C*, the writers believe that tree *A* alone is the source of the dwarf forms of eastern white pine.

The study of the reproduction in the vicinity of tree *A* revealed that of the 422 seedlings counted, 47, or 11.1 percent of the total, exhibited the dwarf habit.

The vegetative characteristics of the specimens were compared with the written descriptions of the eight dwarf varieties of eastern white pine which are given in the literature (*1, 2, 3, 4*). As a result of these comparisons the writers believe that the Penn State specimens are not a new variety but can be identified as *Pinus strobus* var. *nana* Hort. (Fig. 2).

Because of inadequate descriptions in the literature several varietal names have been assigned to this particular form of white pine. With a view to further definition of the variety, a description of the Penn State specimens would seem to have some value.

In general, the individual specimen is a dense globular bush with a slightly flattened top that at 16 years of age is approximately 18 inches in height and crown diameter. Branching begins a few inches above the ground and from this point no central or main axis develops. At the whorls of the branches only one or two branchlets are found, thus differing from the five to six normally present in eastern white pine. They are slender and flexible, growing about two inches in length each year. The needles are about three inches in length and are arranged in dense tufts at the ends of the branchlets. Shedding of the needles begins in the second year and three year old sections of twigs are naked. The terminal buds are ovoid with an acuminate tip and from 1/16 to 1/8 of an inch long. The scales are light to dark brown and closely appressed. Lateral buds are similar but smaller and located below the terminal bud on the twig. None of the specimens found have borne cones.

The plants are most thrifty and have the densest crowns when growing in the open field. Those individuals which became established in the plantations of other species, although retaining the dwarf habit, declined in thrift and died as they became overtopped.

Pinus strobus var. *nana* Hort. has been known to European nursery-

FIG. 2.—This specimen of dwarf eastern white pine was 18 inches high and 16 years of age.

men for many years. While specimens are reported to exist in at least two American arboretums, the confusion existing in the nomenclature of some forms of eastern white pine renders this somewhat indefinite. The significance of the Penn State specimens rests in their natural occurrence and survival under field conditions and the fact that the probable parentage of the trees is known.

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Some Mensurational Aspects of the Level-of-Growing-Stock Problem in Even-Aged Stands

George R. Staebler[1]
Pacific Northwest Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture

FORESTERS CURRENTLY are giving much attention to desirable levels of growing stock in managed stands. Several recent JOURNAL articles (*2, 3, 4, 5, 10*) are evidence of this natural development as forestry shifts to treatment of young growth and "man-made" stands. Also, American foresters are becoming more familiar with European research, which shows that full increment may be obtained on far less growing stock than exists in stands that heretofore have been identified as fully stocked. Results of American research, also, are steadily pointing to this fact.

With our present knowledge regarding growing stock levels for American species, we would undoubtedly be well advised to play it safe and prescribe the best silviculture we know and let the level of growing stock fall where it will. However, there are certain purely mensurational aspects that make it easier to understand the probable effects of a prescribed treatment and thus may alter one's ideas of the best treatment. This article points out some of these aspects for even-aged stands.

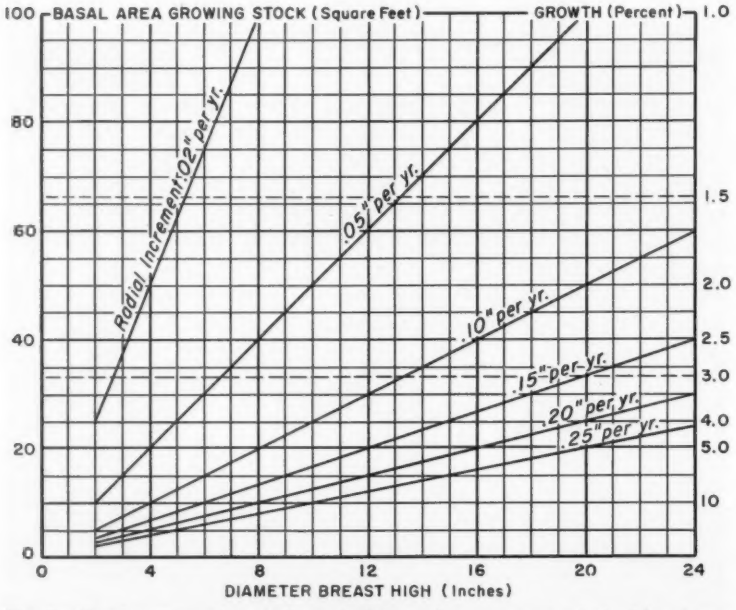

FIG. 1.—Basal area growing stock required to produce one square foot of basal area increment at various radial growth rates and by diameter of tree. Equivalent growth percent shown on right hand scale.

The Nature of Growth and Growing Stock

Basal area.—Annual basal area growth of a tree is very nearly equal to the circumference of the tree at breast height times current radial increment (including both wood and new bark).

Growing stock in a single tree, on the other hand, is the basal area of the tree—the sum of all annual rings, plus bark, laid on to date.

Growth, then, being dependent on tree circumference, is directly proportional to tree diameter; growing stock (basal area) is directly proportional to the square of diameter. These simple relationships permit the development of purely mathematical formulas showing the relation of growth to growing stock in terms of tree

[1]The author is now silviculturist, Forestry Research Center, Weyerhaeuser Timber Co., Centralia, Wash.

diameter and annual radial increment.

Increment in basal area for a single tree may be written:[2]

$$g_{ba} = \frac{\pi dw}{144}$$

where

g_{ba} = basal area increment in square feet
d = d.b.h. in inches
w = current radial growth in inches, including wood and bark

Basal area of a single tree in square feet may be written:

$$b.a. = \frac{\pi d^2}{576}$$

If all trees in a stand are the same size and growing at the same rate, the number of trees, n, required to grow G_{ba} square feet of basal area may be written:

$$n = \frac{G_{ba}}{g_{ba}} = \frac{G_{ba}}{\pi dw/144} = \frac{144\,G_{ba}}{\pi dw}$$

Total basal area of these n trees is the growing stock, $B.A.$, required to grow G_{ba} square feet of basal area and may be written:

$$BA = n\frac{\pi d^2}{576}$$

Substituting for n:

$$BA = \frac{(144\,G_{ba})(\pi d^2)}{(\pi dw)\quad(576)} = \frac{G_{ba}d}{4w}$$

This surprisingly simple equation shows that the basal area growing stock in trees of a common diameter required to produce one square foot of basal area increment is equal to the common diameter in inches divided by four times the annual radial increase in inches.

The equation, shown graphically in Figure 1, indicates how very much greater is the growing stock required to produce a given amount of increment if trees are slow growing rather than fast growing. It is also evident that the required growing stock is greater if it is made up of large trees than of small trees, even when the annual increase in diameter remains constant. That this must be so is evident when one considers that a given total circumference and a given ring width results in a fixed basal area growth. If this given circumference is divided among many small trees, it will enclose less basal area than if it is divided among few large trees. Thus, trees just 4½ feet high have no diameter and hence no basal area, yet are capable of basal area increment. One large tree growing the same amount of basal area as the many 4½-foot trees would have a very great basal area.

Cubic feet.—It is evident that exactly the same reasoning just developed may be applied to cubic measures of growth and growing stock. Annual volume increase of a tree is contained in a sheath of wood laid down on the surface of the tree. Bole area, the total stem cambial surface, is analogous to stem circumference. Volume of the tree compares to basal area. Obviously, neither can be expressed with quite the mathematical precision as can circumference and basal area. Furthermore, each different stand and species would require a new solution since tree form differs among species and stands, and also changes with time in the same stand. That tree form can change as trees grow older is evidence that the width of the annual ring is not the same over the entire bole surface, further complicating a precise solution.

However, approximate formulas can be used to illustrate the solution. Even these are undoubtedly adequate for practical purposes since, as with most biological problems, we cannot hope for precise answers.

An approximate formula for the bole surface of immature ponderosa pine trees has been developed (*6*):

$$b = \frac{dh}{7.2}$$

where b = bole surface in square feet
d = tree diameter in inches
h = height of tree in feet

Bole surface in square feet times the current average radial increase in feet equals current volume growth in cubic feet, g_v:

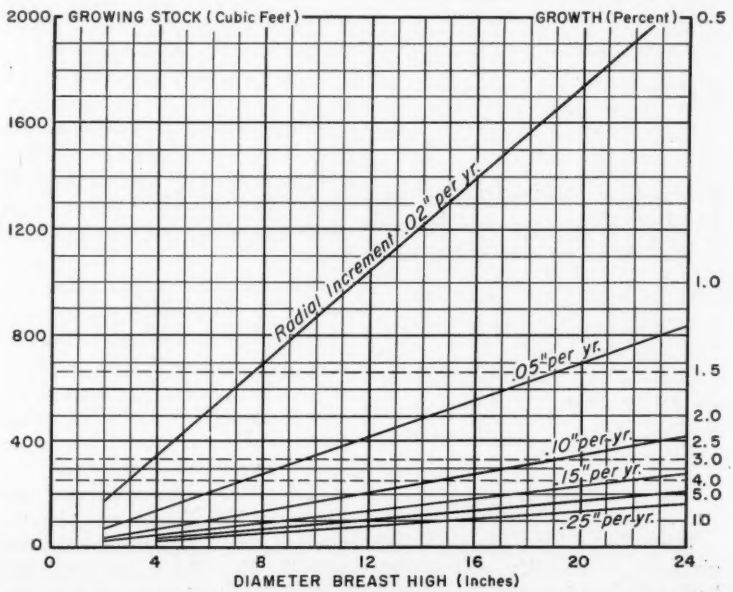

FIG. 2.—Cubic volume of ponderosa pine growing stock required to produce 10 cubic feet of increment at various radial growth rates and by diameter of tree. Equivalent growth percent shown on right hand scale.

[2] A more exact formula would be $G_{ba} = \frac{\pi(dw + w^2)}{144}$. It is evident that when w is small in comparison to d the added term w^2 is of little significance. It is neglected here to simplify later deviations.

$$g_v = b\frac{w}{12}$$

Substituting for b:

$$g_v = \frac{(dh)(w)}{(7.2)(12)} = \frac{dhw}{86.4}$$

Tree volumes may be approximately expressed in an equation of the form (*8, 9*):

$$v = a\,d^2h$$

where v = cubic volume
a = species or stand constant
$d = dbh$ in inches
h = tree height in feet

Fitting an equation of this form to the ponderosa pine volume table (*7*) gives the following equation for the total cubic volume of trees ranging from 4 to 28 inches in diameter and 40 to 140 feet tall:

$$v = .00203d^2h$$

Again, for trees of a common diameter all growing at the same rate, the number of trees, n, required to grow G_v cubic feet of wood is:

$$n = \frac{G_v}{g_v} = \frac{G_v}{dhw/86.4}$$

The total cubic volume of these n trees, or the growing stock, V, required to produce G_v cubic feet of increment, is:

$$V = n(.00203d^2h) = \frac{(G_v)}{(dhw/86.4)}.00203d^2h = \frac{G_v d}{5.7w}$$

It must be emphasized that in this equation w is an average thickness of wood and bark currently grown on the entire bole, which may or may not be equal to radial increment at breast height.

Graphical representation of the equation (Fig. 2) shows the tremendous inefficiency of slow-growing, large trees compared to faster-growing small trees.

Implications

The main utility of the equations given is to simplify and clarify basic relations between growth and growing stock. The equations may be manipulated in a number of ways to give insight into these relations.

Growth percent.—Growth percent for basal area may be written:

$$G\%_{ba} = \frac{(G_{ba})}{(B.A.)}100 = \frac{(G_{ba})}{(G_{ba}d/4w)}100 = \frac{400w}{d}$$

In this form the similarity to Schneider's formula for growth percent will be noted. Schneider used rings per inch instead of annual increase in radius. If w is redefined as the inside bark increase in radius it may be written $1/r$, where r is rings per inch. If $1/r$ is substituted for w in the equation just given, the result, $400/rd$, is identical to Schneider's formula. Schneider, however, arrived at the expression through an entirely different process (*1, p. 459*). His use of growth inside rather than outside bark gives a conservative estimate of growth percent.

For cubic feet the growth percent equation is:

$$G\%_v = \frac{(G_v)}{(V)}100 = \frac{(G_v)}{(G_v d/5.7w)}100 = \frac{570w}{d}$$

Comparison of the basal area and cubic foot expressions shows higher growth percentage by cubic volume for a given radial increase and tree diameter, which is in accord with experience (Figs. 1 and 2).

Increase in growing stock required to compensate for increase in tree diameter.—Figures 1 and 2 bring into perspective the opposite effect of tree diameter and radial growth on the amount of growing stock required for a given increment per unit area. The faster the radial growth the less the growing stock required. The larger the tree the greater the growing stock required. Yet the more rapid the radial growth (low growing stock), the faster are larger trees produced (high growing stock).

Manipulating the equations to evaluate this effect shows: 50 percent of the increment in basal area or 35 percent of the cubic increment must be retained in the growing stock to make up for increase in tree size if radial growth and growth per unit area remain constant. This may be demonstrated for basal area as follows:

Growing stock, BA_1, required to produce G_{ba_1}, square feet of increment at radial growth rate w_1, is:

$$BA_1 = \frac{G_{ba_1}d}{4w_1}$$

Following one year's growth the tree's diameter is $d + 2w_1$. Growing stock then required for areal growth G_{ba_2} at radial growth w_2 is:

$$BA_2 = \frac{G_{ba_2}(d+2w_1)}{4w_2}$$

Difference in the growing stocks, $BA_2 - BA_1$, is the minimum amount of the first year's growth, G_{ba_1}, which must be retained in the growing stock in the second year to prouce G_{ba_2} square feet of increment at radial growth, w_2:

$$BA_2 - BA_1 = \frac{G_{ba_2}(d+2w_1)}{4w_2} - \frac{G_{ba_1}d}{4w_1}$$

If G_{ba_2} equals G_{ba_1} (constant increment per unit area) the expression becomes:

$$BA_2 - BA_1 = G_{ba}\frac{(dw_1 - dw_2 + 2w_1^2)}{(4w_1w_2)}$$

The fraction $\frac{dw_1 - dw_2 + 2w_1^2}{4w_1w_2}$ represents the proportion of G_{ba_1} that must be retained in the growing stock just to make up for the increased diameter of the trees in the stand. If $w_1 = w_2$, that is, radial growth is constant, the fraction becomes $\frac{2w^2}{4w^2}$, or .50. It is further evident that if w_2 is less than w_1, decreasing radial increment, the fraction becomes greater than one-half, and more than 50 percent of increment must be retained in growing stock. With an increasing radial growth, w_2 greater than w_1, less than 50 percent may be retained.

The same derivation with the

cubic volume equations shows that if radial growth and areal increment are constant, 35 percent of the volume growth must be retained in the growing stock each year.

Changes in growth required if growing stock is held level.—We might next ask: Suppose growing stock is held level by periodic removal of all the increment, how much increase in radial growth will be required if growth per unit area is to remain unchanged? Conversely, how much will growth per unit area be reduced if radial increment remains constant?

These questions may be answered from the equations, in the form just given, by setting BA_1 equal to BA_2 (growing stock level) and solving, first for w_2, the required radial growth, in terms of tree diameter, d, and current radial increment, w_1:

$$BA_1 = BA_2$$

$$\frac{G_{ba_1} d}{4w_1} = \frac{G_{ba_2}(d + 2w_1)}{4w_2}$$

If G_{ba_1} equals G_{ba_2} (constant areal increment):

$$w_2 = w_1 \frac{(d + 2w_1)}{(d)}$$

In other words, required radial growth is equal to current growth times tree diameter at the end of the growing season divided by diameter at the beginning of the growing season. Thus 10-inch trees whose current radial growth is .1 inch would have to grow .102 inches to make up for the fact that growing stock is held level by removal of all current increment. In this example, required annual increase would be 2 percent. Though such an increase might conceivably be possible for a short time, it obviously could not be sustained.

Identical results are obtained by starting with the equations for cubic volume.

Next, assuming constant radial increment, $w_2 = w_1$, the equation as set up may be solved for G_{ba_2} with the result:

$$G_{ba_2} = G_{ba_1} \frac{(d)}{(d + 2w)}$$

In other words, if radial growth is constant and growing stock is held level by periodic removal of increment, increment must fall off in proportion to the increase in diameter of the trees.

Again, the same result is obtained by starting with the cubic-volume growing stock equations.

Ratio of cubic foot to basal area growth.—The ratio of cubic foot growth to basal area growth may be determined by solving the cubic foot equation for G_v and the basal area equation for G_{ba} and dividing one by the other:

$$G_v = \frac{5.7\, w\, V}{d}$$

$$G_{ba} = \frac{4\, w\, BA}{d}$$

$$\frac{G_v}{G_{ba}} = 1.425 \frac{(V)}{(BA)}$$

Thus for ponderosa pine the ratio of annual cubic-foot growth to annual basal area growth is 1.425 times the cubic foot-basal area ratio existing in the growing stock. This assumes, however, that the annual radial increase at breast height is equal to the average over the entire bole. If the average radial increment over the bole is greater than that at breast height (as it would be in young trees of improving form) the value of the multiplier would be greater than 1.425.

This relationship shows how cubic growth can be satisfactory even though basal area growth is very small.

Summary

Purely mathematical relationships between growth and growing stock are developed by expressing both in terms of tree diameter and radial increment for basal area, and diameter, height, and radial increment for cubic volume. The simple equations that result reveal clearly how much more growing stock is required for a given amount of increment if annual diameter growth is low and/or trees are large in diameter.

Manipulation of the equations reveals that 50 percent of basal area increment, or 35 percent of cubic foot increment must be retained in growing stock to make up for the increased diameter of the trees, if radial growth and increment per unit area remain constant. If growing stock is held level by periodic removal of increment, either radial growth must increase to hold increment per unit area constant, or, if radial growth is constant, increment per unit area must fall off. Both the increase in radial growth and decrease in areal increment are functions of tree diameter and current radial growth.

The equations may also be converted to a form giving growth percent by basal area and cubic volume.

The ratio of cubic volume growth to basal area growth is also shown as a function of the cubic foot—basal area ratio existing in the growing stock.

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Some Effects of Stand Density and Deer Browsing on Reproduction in an Adirondack Hardwood Stand

Robert O. Curtis and F. M. Rushmore[1]
Northeastern Forest Experiment Station,
Forest Service,
U. S. Department of Agriculture

THE NORTHERN HARDWOOD stands of the Adirondack region of New York constitute a major natural resource, the basis of one of the few year-round industries of the area. However, knowledge of their silviculture and potential productivity is limited.

The results of an exploratory study begun in 1938[2] provide some information about the problems involved in the management of northern hardwoods in the Adirondacks. Three types of cutting were applied in a mature stand located near Newcomb, New York.

[1]The authors are research foresters stationed at the Adirondack Research Center, Paul Smiths, New York, which is maintained by the Northeastern Forest Experiment Station in cooperation with Paul Smiths College. This study was carried on in cooperation with Cornell University.

[2]Established by M. Westveld and B. H. Plusnin of the Northeastern Forest Experiment Station and A. B. Recknagel of Cornell University.

The Study

The study area.—The study was conducted on four contiguous square plots, each 2½ acres in area. All measurements were taken on a 1-acre square in the center of each plot. The remaining 1½ acres served as an isolation strip, receiving the same treatment as the rest of the plot.

The original study contained three plots: "clear-cut," "selection," and "untreated control," established in 1938-39. A fourth plot, "shelterwood," was established in 1949.

The stand composition and size-class distribution of trees on the plots were similar before treatment (Figs. 1 and 2). The average basal area was 112 square feet per acre (trees 6 inches d.b.h. and larger). There were few red spruce (*Picea rubens* Sarg.) of merchantable size in the stand, though some seedlings, saplings, and poles were present. The shelterwood plot contained a few more white ash (*Fraxinus americana* L.) of seed-bearing size than the other plots. No record of the past history of the stand was available.

Soils and drainage were similar on all plots, except that the east one-third of the clear-cut plot was less well drained. The soil was Essex sandy loam (soils map by R. F. Chandler et al., 1939). The floristic cover type was Viburnum (*5*). The plots were located on a well-drained moderate slope of easterly aspect, at an elevation of approximately 1,600 feet.

Plot treatments.—The control plot was not cut or disturbed in any way. On the clear-cut plot, all hardwoods 2½ inches d.b.h. and larger were cut in the winter of 1938-39.

The selection plot received two light cuts: (1) The first, in the winter of 1938-39, left a residual stand of 72 square feet per acre in trees 6 inches d.b.h. and larger. (2) The second, in 1949, removed 29 square feet per acre, leaving a residual basal area of 65 square feet. This last was a simulated cut, done by poisoning. Nearly all the trees removed were poor-quality beech (*Fagus grandifolia* Ehrh.).

One-half of both the clear-cut and selection plots was mowed at the time of initial treatment. All shrubs and hardwood stems less than 2½ inches d.b.h. were cut at ground level.

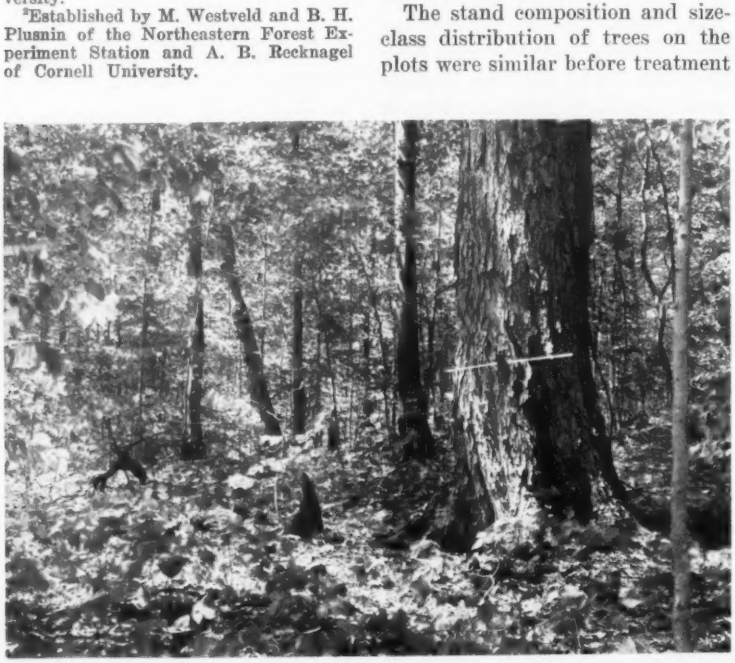

FIG. 1.—Some Adirondack old-growth hardwood stands consist of an overstory of large hard maple, yellow birch, and a few beech, with an abundance of the more tolerant beech in the understory. The development of this understory beech after cutting is a major problem in the management of such stands.

On the shelterwood plot, established 10 years after the others, in 1949, the treatment was a simulated first cut of a two-cut shelterwood. Nearly 57 percent of the basal area was poisoned (mostly beech) in August 1949, leaving 48 square feet per acre in trees 6 inches d.b.h. and larger. No mowing was done on this plot.

At this time—10 years after the first plots were established—it was apparent that white-tailed deer (*Odocoileus virginianus*) were severely browsing reproduction of some tree species. To obtain information on the effects of this browsing, deer exclosures (each 6.6 x 66 feet) were erected on the clear-cut, selection, and control plots in August 1949. A similar exclosure was constructed on the shelterwood plot in July 1952, three years after plot establishment.

Growth in Basal Area

On the control plot, the total basal area gradually increased over the 17-year period of observation (Tables 1 and 2); beech accounted for three-fourths of this increase.

The selection plot had the greatest mean annual basal-area increment: 2.37 square feet per acre. Most of the hard maple (*Acer saccharum* Marsh) and yellow birch (*Betula alleghaniensis* Britton) growth occurred on sawtimber-size trees; most of the beech growth was on pole-size trees. Despite a conscious effort to reduce the proportion of beech in the stand (nearly all trees removed in 1949 were beech), the basal-area growth of beech was equal to that of all other species combined.

By 1955 few of the trees on the clear-cut plot had reached the minimum diameter (6 inches d.b.h.) used in computing basal area.

Develoment of Reproduction

Control plot.—On the control plot, there was little change in the number, size, and species composition of reproduction between 1938 and 1955. Several characteristics were apparent in 1955 (Table 3).

1. Yellow birch reproduction was present only in the 0-1.0 foot height class; there were only 1,200 stems per acre. Under the dense shade of the undisturbed stand this species did not appear to develop further.

2. There were 54,000 hard maple seedlings per acre in the 0-1 foot class. However, there were only 139 stems per acre in sizes from 1 foot high to 5 inches d.b.h.

3. There were 4,600 beech per acre in the 0-1 foot class. While much less numerous than hard maple in this size class, beech appeared to be the only species developing into sapling sizes in any appreciable numbers. There were 3,020 beech per acre in sizes 1 foot high to 5 inches d.b.h.

4. Hobblebush (*Viburnum alnifolium* Marsh.) was present principally in the 0-1 foot height class (4,700 per acre). Though well distributed over the control plot, it did not occupy a high percentage of the available area. As a competitor with tree seedlings it appeared to be of minor importance on this plot.

Since construction of the exclosure, deer appeared to have had little effect on the composition and quantity of reproduction on the control plot. There was little difference between reproduction of tree species inside and outside the deer exclosure. Hobblebush was somewhat more abundant and slightly taller inside the exclosure.

Selection plot.—The light cuttings on the selection plot evidently favored beech over any of the better hardwoods. Even though the hard maple (remaining from the original stand) responded vigorously to the 1939 and 1949 treatments, beech still dominated the sapling and pole-size classes in 1955—in spite of the effort to reduce the proportion of this species.

Although hard maple seedlings 0-3 feet high were abundant in 1938 and in 1955, very few grew into the larger sizes (Table 3). There were few yellow birch seedlings or saplings of any size.

Differences observed in 1955 between reproduction inside and outside the deer exclosure were similar to those noted on the control plot. It appeared that deer have had only a minor influence on reproduction on this plot since the exclosure was erected.

Clear-cut plot.—When remeasured in 1948, the clear-cut plot

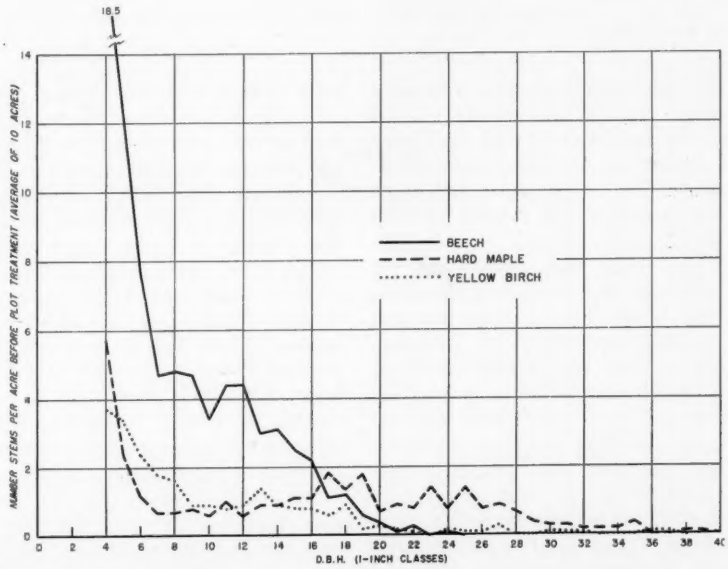

FIG. 2.—The original stand contained few hard maple in the smaller diameter classes. Hard maple reproduction did not appear to be developing into larger size classes in the undisturbed stand.

TABLE 1.—ORIGINAL AND RESIDUAL BASAL AREA ON THE PLOTS, IN SQUARE FEET
(All stems 6 inches d.b.h. and larger)

Treatment	Species	1938-39		1948-49		1955
		Initial	Residual	Before treatment	Residual	
Untreated control	Beech	38	—	49	—	54
	Hard maple	42	—	41	—	46
	Yellow birch	11	—	8	—	11
	Other	1	—	1	—	2
	Total	92	—	99	—	113
Selection cutting	Beech	34	25	35	7	16
	Hard maple	62	38	43	42	47
	Yellow birch	27	9	16	16	19
	Other	0	0	0	0	0
	Total	123	72	94	65	82
Clear-cutting	Beech	35	0	0	—	1
	Hard maple	71	0	0	—	4
	Yellow birch	18	0	0	—	1
	Other	2	0	0	—	3
	Total	126	0	0	—	9
Shelterwood cutting	Beech	—	—	45	3	3
	Hard maple	—	—	53	34	44
	Yellow birch	—	—	9	7	6
	Other	—	—	4	4	5
	Total	—	—	111	48	58

TABLE 2.—MEAN ANNUAL BASAL AREA INCREMENT PER ACRE, IN SQUARE FEET, BY SPECIES, 1938-1955[1]
(All stems 6 inches d.b.h. and larger)

Treatment	Beach	Hard maple	Yellow birch	Others	All species
Untreated control	0.94	0.27	-0.02	0.05	1.24
Selection cutting	1.20	.62	.55	.01	2.37
Clear-cutting	.07	.25	.03	.14	.49
Shelterwood cutting	-.02	1.55	-.12	.14	1.57

[1]All plots based on a 17-year period except shelterwood, which was based on a 6-year period.

was still largely an open, unstocked area. Most of the woody ground cover consisted of red raspberry (*Rubus* spp.), beech, and hobblebush. The numerous hard maple and ash seedlings present in 1938 had failed to survive.

By 1955, tree species on the clear-cut plot were more abundant and larger, but stocking was still unsatisfactory (Table 3). Although there were considerable numbers of hard maple and yellow birch in the 0-1 foot class, beech was the most abundant species in the larger sapling sizes. Approximately one-third of the plot was occupied by hobblebush, raspberry, grasses, and ferns. Vegetation was not uniformly distributed over the plot, and the area resembled an abandoned pasture reverting to forest. There were nearly 700 red spruce per acre over 1 foot high. (The spruce seed source near this plot was better than for the other plots).

Between 1949 (when the deer exclosure was erected) and 1955, the number of hard maple and yellow birch over 1 foot high increased considerably inside the exclosure. There was no such increase outside the exclosure. The number of smaller stems (0-1 foot high) increased about the same outside as inside. (Seedlings of this size are protected from winter browsing by deep snow.)

By 1955 it was apparent that the new stand developing on the clear-cut plot would contain a large proportion of beech, some red spruce, and only a few of the better hardwoods.

Shelterwood plot.—Before treatment in 1949, the reproduction present on the shelterwood plot consisted mainly of 21,000 hard maple seedlings per acre in the 0-1 foot class (Table 4). Beech reproduction was present in all sizes, and among stems over 1 foot high it was the most abundant species.

By 1955 there had been a tremendous increase in the number of seedlings in the 0-1 foot class. Hard maple increased 3-fold, and yellow birch 60-fold. However, outside the deer exclosure very few had grown into larger size classes.

The number of hobblebush stems increased nearly a third between 1949 and 1955, and there was a striking increase in their height.

On the shelterwood plot there was a striking difference between reproduction of tree species inside and outside the deer exclosure. After three years' protection, hard maple, yellow birch, and white ash seedlings over 1 foot high were many times more abundant inside the exclosure (Table 4). The deer exclosure was completely occupied by reproduction over 3 feet high, principally of the three above species. This was in sharp contrast with the area exposed to deer browsing, where beech and hobblebush comprised virtually all of the reproduction of like size.

Effects of Mowing

After 17 years, differences in the species composition of hardwood reproduction on the mowed and unmowed portions were minor, for both the clear-cut and selection plots, and did not appear to be great enough to be of any practical consequence.

On the clear-cut plot there were apparent differences in the amount of hobblebush and red spruce reproduction on the mowed and unmowed portions. Hobblebush was much more abundant and larger on the mowed portion. There were 182 red spruce per acre on the mowed portion, compared to 779 on the unmowed. This last difference may have been due to more favorable conditions on the unmowed area; there was less competition from

TABLE 3.—REPRODUCTION (NUMBER OF STEMS PER ACRE) PRESENT IN 1938 AND 1955[1]

Species	1938	1955	Species	1938	1955	Species	1938	1955
	UNTREATED CONTROL (Basis: 54 milacres)			SELECTION CUTTING[2] (Basis: 32 milacres)			CLEAR-CUTTING[2] (Basis: 32 milacres)	
0.6-5.0 inches d.b.h.:			0.6-5.0 inches d.b.h.:			0.6-5.0 inches d.b.h.:		
Hobblebush	—	0	Hobblebush	—	0	Hobblebush	—	0
Beech	409	360	Beech	311	730	Beech	137	75
White ash	3	2	White ash	0	0	White ash	1	0
Yellow birch	1	0	Yellow birch	20	0	Yellow birch	22	1
Hard maple	52	28	Hard maple	100	83	Hard maple	123	4
3.1 feet high to 0.5 inch d.b.h.:			3.1 feet high to 0.5 inch d.b.h.:			3.1 feet high to 0.5 inch d.b.h.:		
Hobblebush	—	150	Hobblebush	—	3,300	Hobblebush	—	2,300
Beech	320	760	Beech	630	1,100	Beech	32	410
White ash	0	0	White ash	0	120	White ash	0	0
Yellow birch	0	0	Yellow birch	0	0	Yellow birch	0	0
Hard maple	63	37	Hard maple	220	160	Hard maple	32	31
1.1-3.0 feet high:			1.1-3.0 feet high:			1.1-3.0 feet high:		
Hobblebush	—	3,000	Hobblebush	—	13,000	Hobblebush	—	3,500
Beech	790	1,900	Beech	1,400	780	Beech	280	220
White ash	0	220	White ash	130	530	White ash	95	380
Yellow birch	0	0	Yellow birch	32	31	Yellow birch	0	690
Hard maple	63	74	Hard maple	4,700	2,800	Hard maple	9,400	370
0-1.0 foot high:			0-1.0 foot high:			0-1.0 foot high:		
Hobblebush	—	4,700	Hobblebush	—	14,000	Hobblebush	—	1,500
Beech	2,100	4,600	Beech	1,300	3,300	Beech	400	550
White ash	80	2,000	White ash	0	1,300	White ash	160	360
Yellow birch	720	1,200	Yellow birch	220	1,500	Yellow birch	32	3,100
Hard maple	40,000	54,000	Hard maple	42,000	49,000	Hard maple	27,000	6,200

[1]Hobblebush was not measured in 1938.
[2]Unmowed portion only.

dense patches of shrubs; and shade provided better conditions for seedling establishment. Many of these spruce seedlings originated in the partial shade of hardwood saplings left on the unmowed portion in 1939.

Factors Affecting Reproduction

The development of reproduction on these plots appears to have been related to two main factors: (1) competition and (2) deer browsing.

The numerous hard maple seedlings originally present in the 0-1 foot class did not develop after the stands were cut. On the shelterwood plot, this seems clearly to have been due to browsing by deer, since they did develop within the exclosure.

Establishment of the deer exclosures on the control and selection plots in 1949 did not result in further development of the existing numerous small hard maple seedlings, even though the second treatment of the selection plot was made at that time. It seems clear that, at least during the period after the 1949 treatment, competition rather than deer was the critical factor on these two plots. This is in accord with the observations of Webb, et al. (*8*).

TABLE 4.—INFLUENCE OF DEER BROWSING ON REPRODUCTION IN THE SHELTERWOOD PLOT (NUMBER OF STEMS PER ACRE)

Species and size classes	Outside exclosure (Basis: 48 milacres)		Inside exclosure (Basis: 15 milacres)	
	1949	1955	1949	1955
0.6-5.0 inches d.b.h.:				
Hobblebush	0	0	—	—
Beech	254	390	—	—
White ash	0	0	—	—
Yellow birch	16	1	—	—
Hard maple	159	102	—	—
3.1 feet high to 0.5 inch d.b.h.:				
Hobblebush	140	4,400	0	4,100
Beech	140	980	130	470
White ash	0	42	0	1,500
Yellow birch	0	0	0	3,100
Hard maple	0	0	0	130
1.1-3.0 feet high:				
Hobblebush	3,600	10,900	1,600	11,000
Beech	400	2,800	200	1,700
White ash	63	1,300	67	4,600
Yellow birch	0	82	0	18,000
Hard maple	0	820	0	14,000
0-1.0 foot high:				
Hobblebush	10,100	2,600	9,000	4,100
Beech	2,900	350	3,400	870
White ash	8,600	2,200	17,800	5,300
Yellow birch	870	55,000	200	18,000
Hard maple	21,000	73,000	24,000	46,000

On the clear-cut plot the small hard maple seedlings present before cutting in 1938 failed to survive; few were present in even the 0-1 foot class in 1948. It seems probable that shrub competition and exposure of the site strongly influenced establishment and survival of the better species, though deer apparently prevented further development of the seedlings that

did become established and may have assisted in establishing shrub dominance immediately after cutting.

At the time of the 1955 remeasurement, the numbers of living seedlings in the size class 1 foot high to 0.5 inch d.b.h. that showed browsing injury were recorded. The better hardwoods were heavily browsed, even though they comprised only 13 percent of the total stems of tree species and hobblebush: 86 percent of the hard maple stems were browsed, 53 percent of the yellow birch, and 84 percent of the white ash. On the other hand, only about 55 percent of the less palatable beech and hobblebush were browsed, even though they made up 15 and 72 percent, respectively, of the total number of living stems.

The above percentages do not provide a good comparison of actual damage to reproduction of the different species, since the degree of injury and amount of mortality were not evaluated. A better measure of the real effects of browsing is provided by a comparison of reproduction within the deer exclosure with unprotected reproduction outside the exclosures. That comparison clearly indicates that, on the shelterwood plot, deer prevented the growth of reproduction of the better hardwoods into the larger size classes.

It appears that deer were at least partially responsible for the predominance of beech and red spruce on the clear-cut plot. Red spruce is rarely browsed by deer, and beech is not a preferred species (*6*).

The vigorous development of hobblebush after cutting, with the resulting dense shade and heavy leaf litter, may have been an obstacle to the establishment and development of reproduction of the desired tree species. There was a marked increase in both numbers and height of hobblebush on all the treated plots. In 1955 it was a major component of the understory on the selection plot. The relatively light cutting on this plot apparently was sufficient to stimulate development of the small and scattered stems originally present.

A similar development occurred on the shelterwood plot (Table 4). However, within the deer exclosure, reproduction of desirable tree species was already well above the hobblebush by 1955. Apparently hobblebush will not be a serious competitor provided tree reproduction is already established or becomes established and makes rapid height growth during the period immediately after a stand is cut. If this does not occur, hobblebush may well become a major competitor.

It is probable that hobblebush developed in much the same manner on the clear-cut plot, though we have no record of what occurred during the first 10-year period. Since few existing or new tree seedlings survived—due to site exposure, deer browsing, or other causes—the hobblebush, raspberry, beech, and associated minor vegetation took over the area. The clear-cut plot was the only one on which raspberry developed in quantity.

Comparison of conditions inside and outside the exclosures suggests that the influence of deer on the development of hobblebush has been relatively minor.

The Place of Maple in the Stand

Hard maple has generally been regarded as a very tolerant species (*1*), with which there is little difficulty in obtaining reproduction. The literature contains numerous references to the general occurrence of a carpet of small hard maple seedlings beneath mature stands and to the general reproductive aggressiveness of the species (*2, 4*).

The observations made in this study suggest that, under the conditions existing on the study area, hard maple is distinctly less tolerant than the associated beech,[3] and that the presence of abundant hard maple advance reproduction of small seedling size is no assurance of satisfactory regeneration after cutting.

The original stand, before treatment (Fig. 2), consisted mainly of an overstory of large hard maple, with an understory of beech. Beech was present in all sizes, with numerous stems in the sapling and pole-size classes. Except for seedlings less than 1 foot tall, there were very few hard maple in the smaller size classes.[4] It seems apparent that the ability of all size classes to make continued growth in the understory of the undisturbed stand, as shown by beech on the control plot, was not shared by maple.

The light selection cutting (70 square feet basal area per acre residual stand), though it markedly stimulated the growth of the existing beech seedlings, saplings, and poles, did not result in satisfactory development of hard maple reproduction. On the other hand, excellent regeneration and development of hard maple occurred on the shelterwood plot (residual stand 48 square feet basal area per acre), conditions which also favored yellow birch and white ash reproduction.

It is generally recognized that the apparent tolerance of a species may vary rather widely under different climatic and site conditions (*7*), decreasing under conditions of adverse site and severe climate. In the Adirondacks, both site and climatic conditions are probably less favorable than over much of the range of northern hardwoods. While not conclusive, the above evidence does suggest that hard maple on the study area was intermediate between beech and yellow birch in tolerance; and that observations of the behavior of hard maple reproduction, made on other sites and in other regions, may not be entirely applicable here.

Some Management Implications

A single series of four small plots such as this obviously does not provide a sufficient basis for

[3] Others have also cited the greater tolerance that beech has on some sites (*2, 4, 7, 8*).

[4] It may be noted that this type of stand (Fig. 1 and 2) is common in the region. A similar absence of maples in the smaller size classes has been noted by the authors on other similar areas.

any broad generalizations on the management of Adirondack northern hardwoods. It does, however, bring out a number of points that deserve consideration by the land manager.

Maple advance reproduction.—The presence of large numbers of small hard maple seedlings in the understory is characteristic of mature northern hardwood stands. The presence of these small seedlings is not in itself an assurance of satisfactory regeneration after cutting. The adequacy of advance reproduction should be judged in terms of stems of larger size.

Beech a major problem.—An abundance of aggressive understory beech appears to be one of the principal management problems on Adirondack sites such as the one studied. Beach on these sites is a low-value species because of poor form and cull. Here any system of management that has sawtimber production as its objective should aim to reduce the beech component in favor of hard maple and yellow birch.

The results obtained in this study suggest that light selection cuttings, of the sort often recommended for northern hardwoods in other regions (*2, 3*), may not be applicable to stands and sites similar to this one. On these plots, light cuttings resulted in a continuing deterioration of stand composition, due to development of the tolerant understory beech.

Among the treatments applied in this study, the shelterwood cutting (48 square feet per acre residual basal area) has clearly favored reproduction of the preferred species—hard maple, yellow birch, and white ash—over that of beech. This suggests that under similar site and stand conditions, best reproduction may be obtained by a fairly heavy initial cut, removing as much as possible of the beech component.

Deer damage may be serious.—It has been shown that deer exerted a strong influence on the composition and development of reproduction on the shelterwood and clear-cut plots. Several factors may have contributed to this; these were small areas of reproduction in the midst of uncut timber; they were located within ¼ mile of deer yarding areas; and they were near extensive areas where hunting is restricted or prohibited. However, it is apparent that deer damage can be serious and that the possible influence of a large deer herd must be considered in the management of northern hardwoods.

Summary

Observations on the development and reproduction of Adirondack northern hardwoods were made over a 17-year period on four 2½-acre plots cut under different specifications. The treatments were clear-cut, light selection, shelterwood, and control. The principal results were:

1. A complete clear-cutting failed to give satisfactory regeneration of the better hardwoods.

2. On the selection plot, first and second cuts at 10-year intervals, each reducing the basal area to approximately 70 square feet per acre, resulted in increased numbers and size of understory beech, without any appreciable increase in hard maple and yellow birch reproduction.

3. On the shelterwood plot a first cut, reducing the basal area to approximately 50 square feet per acre, resulted in excellent reproduction of hard maple, yellow birch, and white ash.

4. Deer have had a marked effect on the amount and composition of reproduction.

5. Mowing of advance reproduction had only minor effects on regeneration of hardwoods.

6. The presence of abundant and aggressive beech in the understory appears to be a major problem in the management of this and similar stands. It is suggested that a moderately heavy initial cut may be necessary to obtain a desirable proportion of hard maple and yellow birch in the reproduction.

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Cone and Seed Size of South Florida Slash Pine and Their Effects on Seedling Size and Survival

O. Gordon Langdon
Southeastern Forest Experiment Station,
Forest Service,
U. S. Department of Agriculture

SOUTH FLORIDA slash pine (*Pinus elliottii* var. *densa* Little and Dorman) once grew in pure even-aged stands on more than 2 million acres of peninsular Florida (*6, 7*). Over one half of this area is now poorly stocked or denuded because of wildfires and past timber cutting. In the past, attempts to restock these cutover lands by planting south Florida slash pine have often failed because of poor first year survival. Inferior nursery stock, improper handling and planting, and rigorous site conditions with alternate periods of high ground water and drought were some of the factors contributing to seedling mortality. To improve the quality of the planting stock (Fig. 1), it is desirable to understand the effects of cone, seed, and seedling size on seedling growth and survival.

Past Work

Past work with cone size in other pines has been concerned mainly with its relation to seed yields and to germination. Studies of red pine have indicated that production of viable seed increases with cone size (*14*). A study of pitch pine showed that the larger cones yielded heavier seed with somewhat better germination than the lighter seed from medium and small cones (*10*). However, in this study the small and medium sized cones of shortleaf pine contained more viable seed than did the large cones (*10*).

Seed weight, or size, has been found to have an effect on the germination, survival, or early size of seedlings of Scots pine, eastern white pine (*8, 9, 12*), and red pine (*3*). Seed size of ponderosa and Jeffrey pines did not affect survival in transplant beds but did affect growth for the first three years (*2*).

Seedling size is usually an important factor in survival and early growth. The larger seedlings usually survive and grow best, although the southern pines are exceptions to this rule (*15*). Jack pine and red pine survive best when the smallest and poorest seedlings are discarded (*11, 13*), but for ponderosa and Jeffrey pine, seedling size may have little effect on survival until the second year after planting (*2*). For shortleaf pine, the seedlings with the smallest stem diameter usually had the poorest survival, while seedling height alone had little effect. The seedlings with low height-diameter ratios generally had the best survival (*1*).

Procedure

Since nothing has yet been reported on any of these relationships for South Florida slash pine,[1] the study reported here was designed to provide such information. The study was made in cooperation with the Florida Board of Forestry, The Atlantic Land and Improvement Company, and the Collier Enterprise. The seed used was taken from a 250-bushel lot collected from a large mature stand in Hendry County, Florida, in October 1952.

Cone grades. — Ten ½-bushel samples were selected at random

[1]This species was recognized as a new variety of pine in 1952 by Little and Dorman (*4, 5*).

FIG. 1.—One-year-old seedling of South Florida slash pine, showing the characteristic carrot-like tap root and short, thick stem.

from the 250-bushel lot, combined into one 5-bushel sample, and then graded into 3-, 4-, 5-, and 6-inch length cone size classes. The cone sizes ranged from 2½ to 6½ inches in length. In the sample used, 19 percent were in the 3-inch class, 56 percent in the 4-inch class, 22 percent in the 5-inch class, and only 3 percent in the 6-inch class. Although the range of cone sizes for the two varieties of slash pine overlap, cones of South Florida slash pine are smaller than those of common slash pine (*5*). In this study the cones averaged 246 cones per bushel, nearly one-fourth more than for common slash pine (*15*).

Seed grades.—A ½-bushel lot of cones from each cone size class was allowed to dry and open at room temperature in separate screen-wire trays. After the cones opened, the seed was extracted and dewinged by hand rubbing. The seed was cleaned with a 14-inch fan. The fanning was vigorous enough to remove all of the wings and nearly all of the empty seeds. Cutting tests with ocular inspection of the seed showed that 95 percent or more of the seed in each cone-length class had normally developed endosperms.

Eight random samples of 200 sound seeds each were taken from each cone class to obtain seed weight by cone length. The air-dried seed from each cone class was then separated into seed-size classes by using U. S. Standard sieve sizes of square mesh:

Seed size *Class*	Size range *Millimeters*
Extra large	4.00+
Large	3.36—4.00
Medium	2.83—3.36
Small	2.38—2.83
Small	2.00—2.38
Small	1.41—2.00

An additional four random samples of 100 seeds each were selected from each cone and seed class and weighed to determine relation of number of seed and weight for all combinations of seed and cone sizes.

The seed from each cone and seed class was then planted in the Keri nursery[2] on April 7, 1953, in a randomized block design with two replications. Prior to sowing, the nursery beds were treated with 1,000 pounds of 6-6-6 fertilizer and 500 pounds of superphosphate per acre. The seed was sown at the rate of 25 seeds per lineal foot. The seedbed density was fairly uniform, with about 12.6 seedlings per lineal foot, except for the small and extra large seed-size classes which averaged only 4.2 and 8.8 seedlings per lineal foot. Seedlings from these two seed-size classes were not outplanted. Normal irrigation and weed control practices were followed until seedlings were lifted in December, eight months later.

Seedling grades. — After being lifted, the seedlings from each cone and seed class were graded into large, medium, and small size classes based on stem height and diameter at root collar. The extra large and small seed classes, because of the small amount of seed, did not produce the minimum number of 300 seedlings required for outplanting. These treatments (classes) were dropped from study after seedling height, diameter, and weight had been measured.

The three seedling grades used were based on the following height (root collar to bud tip) and stem-diameter sizes:

Seedling grade	Seedling height *Inches*	Stem diameter *Inches*
Small	1 - 3	Less than 1/16
Small	1 - 2	1/16 - 1/4
Medium	1 - 2	1/4 - 3/8
Medium	2 - 3	1/16 - 1/4
Medium	3 - 4	Less than 1/16
Large	2 - 3	1/4 - 1/2
Large	3 - 8	1/16 - 1/2

It should be pointed out that the seedling grades used combined both stem diameter and height measurements and in view of Chapman's findings (previously discussed), the combination may have modified the survival by seedling grades.

After being graded, the seedlings were placed in bundles of 25 and weighed (green weight) as a check on seedling grading procedure. The check showed that within a given cone-seed size class the seedlings of different grade were of significantly different green weight.

Outplanting. — The seedlings were outplanted in a randomized split-plot design with four replications. Twenty-four different grades were planted, based on the combinations of four cone grades, two seed grades, and three seedling grades.

Effect of Grades on First-Year Survival and Growth

One year after field planting, seedling survival among seed grades by cone lengths was very significantly different. Large seed from small cones gave best survival. There was a significant interaction between cone length and seed size,

TABLE 1.—SEEDLING SURVIVAL ONE YEAR AFTER PLANTING, BY CONE, SEED, AND SEEDLING GRADES, SOUTH FLORIDA SLASH PINE

Cone length (Inches)	Seed size	Seedling grade: Large	Medium	Small	Average
		Percent			
3	Large	83	87	81	83.7
3	Medium	51	67	48	55.3
4	Large	88	86	75	83.0
4	Medium	51	58	58	55.7
5	Large	78	74	69	73.7
5	Medium	85	76	80	80.3
6	Large	60	71	51	60.7
6	Medium	40	33	41	38.0
Average, large seed		77.3	79.5	69.0	75.3
Average, medium seed		56.8	58.5	56.8	57.3
Average, all seed		67.0	69.0	62.9	66.3

[2]Owned and operated near La Belle, Florida, by the Atlantic Land and Improvement Company.

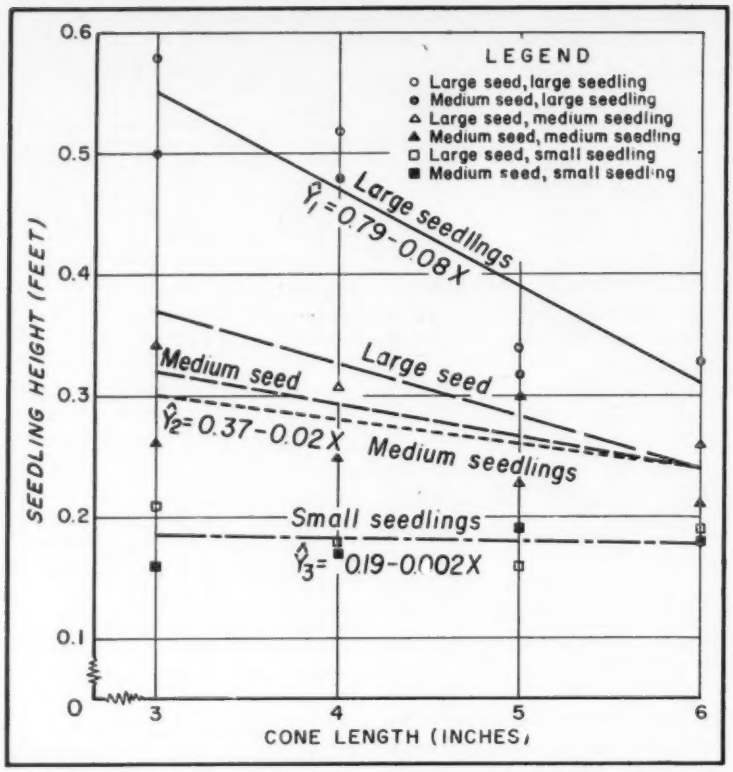

FIG. 2.—Effect of cone, seed, and seedling grades on seedling height one year after planting, South Florida slash pine.

attributable to a reversal in the 5-inch cone length group (Table 1). Survival of large, medium, and small seedlings was 67.0, 69.0, and 62.9 percent, respectively. These differences were not significant at the 5 percent level, but they were significant at about the 10 percent level.

In spite of the fact that differences in seedling growth are characteristically narrow for this species, an analysis of total height 1 year after field planting did reveal several significant trends. As expected, the average seedling heights —0.43, 0.27, and 0.18 feet for the large, medium, and small seedling grades respectively—were significantly different. As in survival, the heights of the seedlings from seed of a given size showed a highly significant inverse relation to cone size. Differences in height attributable to seed size one year after outplanting were not significant at the 5 percent level. The interaction between seedling and cone grades was highly significant, and is illustrated in Figure 2 by the slope of the regression.

Cone, Seed, and Seedling Characteristics

Cone and seed sizes.—A definite relationship was found between cone length and seed-size distribution. This relationship is illustrated by Figure 3, which shows the percent distribution of seed by seed and cone size on a cumulative basis. Percentage-wise, small cones had more small seed than large cones. In the 3-inch cones, 74 percent of the seed was in the small and medium size classes; in the 4-inch cones, 54 percent; in the 5-inch cones, 32 percent; and in the 6-inch cones only 29 percent of the seed were in these sizes. Small cones also had more sound seed per pound, with an average of 20,400, 17,800, 15,900, and 12,600 seed for the 3-, 4-, 5-, and 6-inch cones, respectively. This relationship is shown in Figure 4 by the regression line and reflects the above percent distributions of sound seed by seed sizes and cone lengths.

Seedling grades.—The percentage distribution of small, medium, and large seedling grades was 37.5, 43.1, and 19.4 percent, respectively, for all cone and seed sizes. When the seedlings were graded, a tally was made of the number in each stem-height and diameter class to determine the size class distribution. These data, which are based on 3,929 trees, are summarized in Table 2. The most common size with 29 percent of trees was 1 to 2 inches tall and 1/16 to 1/8 inch in diameter. About three-fourths of the seedlings tallied were between 1 and 3 inches tall and had a stem diameter of 1/16 to 1/4 inch.

Seedling grade at time of lifting was related to cone and seed size, and seedling weight was correlated with seed size. The larger seed tended to produce larger seedlings. Fifty-nine percent of the seedlings from small seed were graded as small seedlings, but only 27 percent from extra-large seed were so graded (Table 3). Similarly, on the basis of seedling weight, seedlings from extra-large seed weighed on an average 9.1 grams, but those from small seed averaged only 5.2 grams (Fig. 5).

The data in Table 4 show that for a given seed size the seed from small cones produced a higher proportion of large seedlings than did the seed from large cones. The reason seems to be that, for example, medium seed (2.83 to 3.36 mm.) represented the poorer seed from large cones but the better seed from small cones.

Discussion

First-year survival of planted seedlings in south Florida is one of the most crucial problems in reforesting cutover lands. Since there are a number of factors causing seedling mortality, each technique that improves survival is a step forward. In this study, grading seed, and to a lesser extent the cones, affected survival, but grading the seedlings from seeds of a given size had only a slight influence on survival.

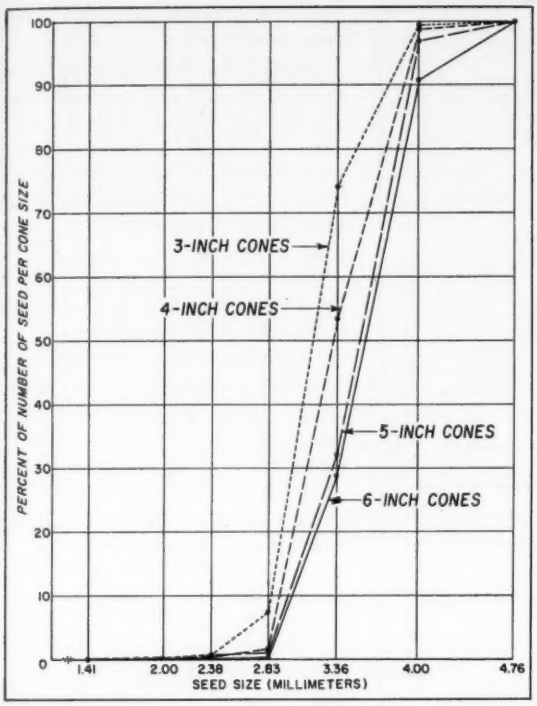

FIG. 3.—Cumulative percent distribution of seed by cone and seed sizes, South Florida slash pine, 1952 cone crop.

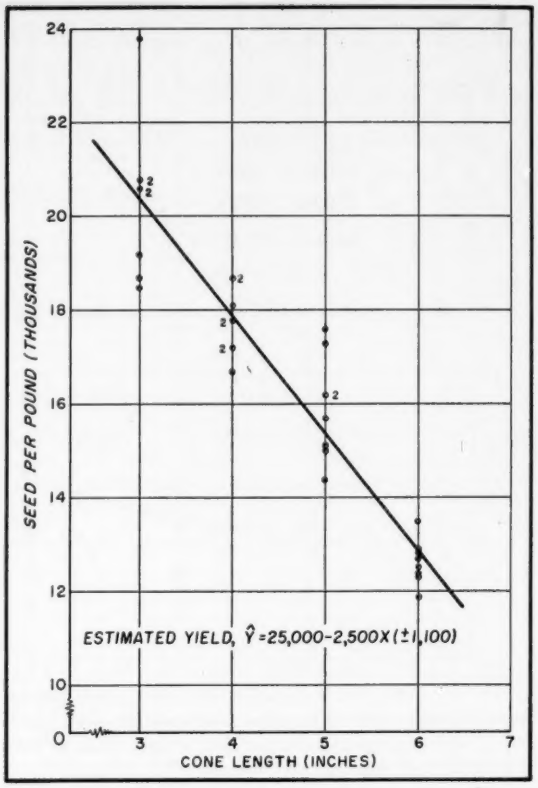

FIG. 4.—Regression estimate of number of sound seed per pound (Y) by cone length (X), South Florida slash pine, 1952 cone crop. Each point represents a 200-seed sample for a given cone-length class.

There are advantages to grading seed other than those of survival. Sowing rates in the nursery can be more closely controlled with graded seed. With graded seed, there will also be more uniformity in seedling size in the nursery bed, and the desired size can be attained by fertilization, which will result in fewer small seedlings. If these small seedlings are normally culled, lower proportion of culls would result in a lower cost of nursery stock. When planting seedlings from small seed, the expected mortality can be offset by planting closer than usual.

Grading by seedling sizes was effective in separating slow and fast growers during the first year. How long this effect will continue is unknown, but growth differences for other species have not been great after 10 or 15 years. Thus, for present grading recommendations, more weight has been given to survival results and considerations affecting planting costs than to early growth differences.

Intermediate-size cones may be

TABLE 2.—PERCENT DISTRIBUTION OF 1-0 SEEDLINGS BY STEM HEIGHT AND DIAMETER, SOUTH FLORIDA SLASH PINE

Height class (Inches)	Stem diameter class (inches)					
	1/16	1/16-⅛	⅛-¼	¼-⅜	⅜-½	Total
	Percent					
0-1	0.1	---	---	---	---	0.1
1-2	2.9	29.1	5.0	0.1	---	37.1
2-3	0.4	22.4	20.6	0.9	0.1	44.4
3-4	0.1	6.7	7.2	0.5	---	14.5
4-5	---	1.3	1.5	0.1	---	2.9
5-6	---	0.2	0.6	---	---	0.8
6-7	---	0.1	---	---	---	0.1
7-8	---	---	0.1	---	---	0.1
Total	3.5	59.8	35.0	1.6	0.1	100.0

TABLE 3.—PERCENT OF SEEDLINGS BY SEED SIZE AND SEEDLING GRADE, SOUTH FLORIDA SLASH PINE

Seed size	Seedling grade			
	Small	Medium	Large	Total
	Percent			
Extra-large	26.9	53.1	20.0	100.0
Large	31.3	46.4	22.3	100.0
Medium	43.2	39.1	17.7	100.0
Small	59.4	35.2	5.4	100.0
Average	37.5	43.1	19.4	100.0

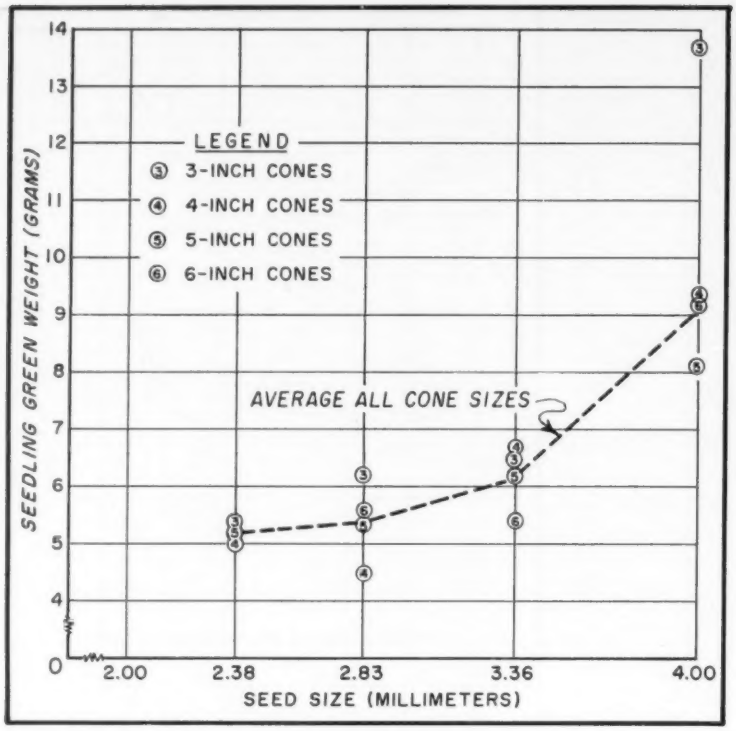

FIG. 5.—Relationship of seedling green weight to seed size and cone size, South Florida slash pine.

TABLE 4.—PROPORTION OF LARGE SEEDLINGS PRODUCED BY EQUAL NUMBERS OF SEED OF DIFFERENT SIZES OBTAINED FROM CONES OF DIFFERENT LENGTH

Cone length (Inches)	Seed size			
	Extra large	Large	Medium	Small
	Percent			
3	43.8	36.6	34.8	10.5
4	35.7	27.9	17.2	1.5
5	15.0	22.4	6.9	0.0
6	18.0	3.9	10.7	0.0
Average	20.0	22.3	17.7	5.4

the best size to collect on the basis of yield of sound seed per bushel of cones. In this study 4-inch cones yielded 22,300 sound seed per bushel of cones. Although the 6-inch cones yielded the highest *percentage* of large seed, 4- and 5-inch cones yielded the highest *number* of large seed per bushel of cones.

In 1952, the yield of sound seed per pound was highly correlated with cone size. If this relationship between cone size and seed size is consistent from year to year, it can be used to estimate the number of seed per pound for a given cone lot merely by sampling for cone size.

The cone-seed relationship may also help to explain the variation from year to year in number of sound seed per pound for other species. For example, variation in performance of seedlings from different seed sources might in certain instances be explained by cone and seed size relations.

Summary

Grading seeds for size was effective in separating seedlings of significantly different survival capacities when field planted in South Florida. Large seeds from small cones resulted in the best survival. Large and medium-size seedlings survived slightly better than small ones.

Grading by seedling sizes separated slow and fast growers during the first year after field planting. Large seedlings from small cones grew best during this period. Seed size did not significantly affect total height at one year after planting.

Preliminary recommendations for South Florida slash pine based on results of this study are:

1. Collect the ordinary-sized cones in preference to the larger ones. Grading of cones as a separate procedure is not recommended.

2. Grade seed by size to facilitate survival, nursery management, and seedling production.

3. Grade seedlings if seedling size will facilitate planting. It may help survival also.

4. In other research studies with this species, such as a seed-source study, cone and seed sizes should be evaluated to determine their effect on the results.

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A Preliminary Report on Field Grafting[1]

James T. Greene and M. Reines
Forest Genetics Research,
School of Forestry,
University of Georgia, Athens.

AS THE interest in establishing seed orchards develops, there is need for more information relative to methods of vegetative propagation in the field.

This study was designed to test the feasibility of bottle grafting and modified soft tissue grafting during the height of the growing season. Several investigators prefer the use of soft tissue and bottle grafts (1, 2, 3, and 4).

To eliminate the possibilities of genetic variation, scion material was collected from one 17-year-old slash pine (*Pinus elliottii* var. *elliottii* Little and Dorman). The scions were gathered on June 4, 1957, and grafted within one hour after collection. Both scion and stock material were growing when the grafts were made.

Two types of grafts were used in this study: (1) bottle graft and (2) a modified soft tissue graft. A total of 20 grafts were made on 4-year-old loblolly (*Pinus taeda* L.) stock. A randomized block design was utilized with ten replications.

In the modified soft tissue method, the scions are inserted into the portion of decapitated stock by the cleft graft method. The top of the stock was cut downward for three inches with a sharp knife. The base of the scion was shaped in the form of a wedge three inches long. It was then inserted into the cleft of the stock. The scion and stock were joined together so that their cambium layers were in good alignment. The grafted portions were then tied with standard grafting rubbers. A handful of moist sphagnum moss was then applied to the union with the tip of the scion exposed. The moss was held in place by a sheet of polyethylene plastic tied at the two ends with wire. The graft was covered with aluminum foil to reduce heat and conserve moisture (Fig. 1). Figure 2 is a completed modified soft tissue graft.

FIG. 1.—A modified soft tissue graft.

In the bottle grafting, long cuts of four inches in length were made along the side of the scion and stock plant. The cuts were within tissue of the current year's growth. The cambium layers of each were matched as closely as possible. They were then tied firmly with grafting rubbers and coated with grafting wax. The base of the scion was inserted into a six-inch glass vial containing water. The vial was tied to the stock plant with grafting wire (Fig. 3).

After the bottle grafts were six weeks old, the stock stem and branches were cut back about three inches. Thereafter, the stock was cut back approximately three more inches at two-week intervals.

The results of this study show that there is a highly significant difference between the bottle graft and the modified soft tissue graft. Fifty percent of the bottle grafts

[1]This work was done in cooperation with the Georgia Forest Research Council and the Georgia Forestry Commission. Journal Series Paper No. 53 of the College Experiment Station, University of Georgia, Athens.

FIG. 2.—A modified soft tissue graft completed.

were successful as compared to only ten percent of the modified soft tissue graft.

This study also demonstrates that grafting can be done successfully when the scion and stock are actively growing. Bottle grafting can therefore be carried on throughout most of the year. This would permit more time for other phases of tree improvement work.

It offers an alternate method which may be used to good advantage in the practice of establishing seed orchards.

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FIG. 3.—A bottle graft.

Resources for the Future Forum

Begun in January, Resources for the Future, Inc., is sponsoring a series of six public lectures under the title of "Natural Resources Conservation in the United States—History and Prospects."

Held in the assembly hall of the Cosmos Club in Washington, D. C. at 8 p.m. on the following dates, topics and speakers are listed as follows:

"Fifty Years of Conservation Thought and Action." Ernest S. Griffith, director, Legislative Reference Service, The Library of Congress.—January 9

"Science, Technology, and Natural Resources." Thomas B. Noland, director, Geological Survey, U. S. Department of the Interior.—January 23

"How Much Should a Country Consume?" John Kenneth Galbraith, professor of economics, Harvard University.—February 13

"Urban Growth and Natural Resources." Luther Gulick, president, Institute of Public Administration.—February 27

"Problems in the Political Economy of Natural Resource Use." Edward S. Mason, dean, Graduate School of Public Administration, Havard University.—March 13

"Organizational Co-operation for Resource Conservation and Development." Gilbert F. White, professor of geography, University of Chicago.—March 27

Following the principal speaker in each instance designated individuals discuss the topic. It is expected that the texts of lectures and discussion papers will be collected into a book to be published by the Johns Hopkins Press.

Statistics from Schools of Forestry for 1957: Degrees Granted and Enrollments

Gordon D. Marckworth
Dean, College of Forestry, University of Washington, Seattle

This article is another in a series of comparable papers appearing annually in the Journal of Forestry since 1934, reporting the enrollment at the schools of forestry and the numbers of degrees conferred. Statistics of this type were first assembled when the Forest Education Inquiry made its study in 1929-1931, and were published in the Inquiry's report in 1932[1] The annual articles in the Journal have brought to date the figures for each successive year.[2]

THE INCREASE in enrollment which began in the 1953-54 scholastic year has continued this year and totals nearly 7 percent, increasing from 6,933 to 7,395. This is the largest enrollment since the fall of 1949 which totaled 7,469. All classes again show an increase in enrollment but by a greatly reduced number than last year. The freshman and sophomore increase dropped to only 10 and 24 respectively, the juniors to 210, and the seniors to 218 (see Table 6).

Once again *General Forestry* accounts for two-thirds of the enrollment in the junior and senior classes. *Wildlife Management* ranks second with 11 and 9 percent in the junior and senior classes. *Wood Technology and Utilization* follows with approximately 8 percent in both classes.

The master candidates increased from 430 to 500 and the candidates for the doctorate from 165 to 179. Of the total graduate enrollment of 679, 49 percent are in *General Forestry*; 19 percent in *Wildlife Management*; and 16 percent in *Wood Technology and Utilization.*

The number of bachelor degrees granted increased from 887 in 1956 to 1,174 in 1957, of which 763 were in *General Forestry*, 115 in *Wood Technology and Utilization*, and 104 in *Wildlife Management.*

The number of master degrees granted decreased from 233 to 223 of which 123 were in *General Forestry*, 32 in *Wood Technology and Utilization*, and 33 in *Wildlife Management.*

The number of doctor degrees granted increased from 34 to 48 of which 26 were in *General Forestry*, 12 in *Wood Technology and Utilization* and 4 in *Wildlife Management.*

From 1900 through 1957 there have been 25,424 undergraduate forestry degrees granted in the United States. In addition 4,593 master degrees and 452 doctor degrees have been granted (see Table 10).

Introduction

The 1957 statistics from the schools of forestry in the United States are on the same basis as for 1956, except that the Michigan College of Mining and Technology has moved from the non-accredited to the accredited group. This has increased the number of accredited schools to 27 and dropped the non-accredited to 10.

It has been customary to carry the statistics on the number of degrees granted on a calendar year basis and since the reports are requested in October, the schools operating on a quarter basis have to estimate the number of degrees which will be granted at the end of the autumn quarter. It thus becomes necessary to correct these estimates at the end of the year. For this reason the totals listed for 1956 in the current compilation are slightly different from those listed last year.

The statistics on degrees granted and enrollment of graduate students were first broken down by specialized curricula in 1953. In 1954 this breakdown was extended

[1]Graves, H. S. and C. H. Guise. Forest education. Yale Univ. Press, New Haven.

[2]Guise, C. H. (Eighteen articles on degrees granted and enrollments at schools of forestry in the United States, 1934-1950). Jour. Forestry 32:337-343; 33:402-405; 34:114-120; 35:77-83; 36:12-18; 37:197-202; 38:241-246; 39:359-364; 40:196-202; 41:87-91; 42:357-360; 43:172-175; 44:110-114; 45:174-180; 46:168-173; 47:93-100; 48:165-169; 49:7-12.
Marckworth, Gordon D. Jour. Forestry 50:262-265; 51:256-259; 52:354-358; 53:256-261; 54:316-321; 55:115-121.

TABLE 1.—SIGNIFICANT STATISTICS FOR 1951 THROUGH 1957

	1951	1952	1953	1954	1955	1956	1957
Bachelor's degrees conferred	1,564	1,267	1,045	957	829	887	1,174
Master's degrees conferred	267	226	151	179	194	233	223
Doctor's degrees conferred	21	25	37	44	31	34	48
Undergraduates enrolled	4,799	4,691	4,909	5,357	6,038	6,933	7,395
Members of freshman class	1,370	1,536	1,698	1,986	2,149	2,220	2,230
Members of sophomore class	1,107	1,012	1,168	1,377	1,566	1,807	1,831
Members of junior class	1,053	1,013	917	1,032	1,236	1,549	1,759
Members of senior class	1,269	1,130	1,126	962	1,087	1,357	1,575
Graduate students—master's	344	281	349	423	405	430	500
Graduate students—doctor's	137	130	139	127	161	165	179

TABLE 2.—BACHELOR DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS 1956 AND 1957

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
Alabama	9	23	3	—	—	—	—	—	—	—	—	—	12	23
California	25	32	—	—	—	—	—	—	—	—	—	—	25	32
Colorado	11	12	8	12	8	7	11	15	6	10	—	—	44	56
Duke	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Florida	9	16	—	1	—	—	—	—	—	—	—	—	9	17
Georgia	30	44	—	—	—	—	3	8	—	—	—	—	33	52
Idaho	10	19	1	4	3	4	5	2	—	—	1	2	20	31
Iowa	18	8	11	21	—	4	—	—	—	—	—	—	29	33
Louisiana Poly. Inst.	13	14	—	—	—	—	—	—	—	—	—	—	13	14
Louisiana State	22	25	1	—	—	—	7	—	—	—	—	—	30	25
Maine	22	27	—	—	—	—	8	13	—	—	—	—	30	40
Massachusetts	13	18	—	—	—	—	9	3	—	—	—	—	22	21
Michigan Mining	19	33	—	—	—	—	—	—	—	—	—	—	19	33
Michigan State	19	25	7	6	—	—	8	20	4	7	26	99	64	157
Michigan Univ.	34	21	9	4	—	—	2	8	—	—	7	5	52	38
Minnesota	15	36	2	3	—	—	6	5	—	—	11	6	34	50
Missouri	12	23	—	—	—	—	—	—	—	—	2	3	14	26
Montana	18	27	3	3	2	3	1	—	—	—	—	—	24	33
New York	46	52	21	25	—	—	—	—	—	—	28	25	95	102
North Carolina	23	26	4	8	—	—	—	—	—	—	—	4	28	38
Oregon	38	45	5	3	—	—	—	—	—	—	—	—	43	48
Pennsylvania	41	48	9	6	—	—	—	—	—	—	—	—	50	54
Purdue	25	34	2	4	—	—	—	—	—	—	—	—	27	38
Utah	15	9	—	—	5	13	7	18	—	—	—	—	27	40
Washington Univ.	32	29	12	7	—	—	—	—	—	—	—	—	44	36
West Virginia	10	18	2	8	—	—	—	5	—	—	—	—	12	31
Yale	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	529	664	100	115	18	31	67	97	10	17	76	144	800	1,068
Schools not accredited														
Arkansas	9	11	—	—	—	—	—	—	—	—	—	—	9	11
Connecticut	6	8	—	—	—	—	5	1	—	—	—	—	11	9
Mississippi	3	16	—	—	—	—	—	—	—	—	—	—	3	16
New Hampshire	6	2	—	—	—	—	4	2	—	—	—	—	10	4
Oklahoma	18	29	—	—	—	—	—	—	—	—	—	—	18	29
Rutgers	4	3	—	—	—	—	—	—	—	—	—	—	4	3
Texas (S. F. Austin)	6	4	—	—	—	—	—	—	—	—	—	—	6	4
Univ. of the South	5	3	—	—	—	—	—	—	—	—	—	—	5	3
Virginia Poly. Inst.	7	14	—	—	—	—	1	1	—	—	—	—	8	15
Washington State	9	9	—	—	2	—	2	3	—	—	—	—	13	12
Total	73	99	—	—	2	—	12	7	—	—	—	—	87	106
Grand total	602	763	100	115	20	31	79	104	10	17	76	144	887	1,174

to the enrollment of undergraduate students in the junior and senior classes. At that time it was found that there was little segregation during the first two years and a breakdown of the enrollment in those classes would be virtually impossible.

The same five broad classes used for the past four years have been used again this year. These are *General Forestry, Wood Technology and Utilization, Range Management,* and *Forest Recreation.* Those curricula falling out of these broad classes have been grouped under the heading *Others.*

While each of these classes was described for 1953 (Jour. Forestry 52:354-358) and 1954 (Jour. Forestry 53:256-261), they are being repeated for clarity. The statistics grouped together under the heading of *General Forestry* cover those phases of forestry dealing with the growing and harvesting of forest crops. The primary emphasis is placed on the production of the crop and the management of the forest land. Not included are such curricula as "Conservation." In the graduate field specialization in the fields of forest soils, silviculture, mensuration, protection, economics, valuation, and regulation are included. Since logging (logging engineering and forest engineering) is a phase of harvesting it has been included under this heading.

The statistics grouped together under the heading of *Wood Technology and Utilization* cover those phases which, though tied to the production of the crop, are concerned primarily with the wood itself and its utilization. Not included are specialized curricula in chemical utilization, plastics, pulp and paper manufacturing, furniture manufacturing, packaging and similar specializations. These have been grouped under *Others* along with Conservation Education, Rural Land Use Planning, Landscape Gardening, Soil Conservation, Light Construction, and Lumber Merchandising. *Range Management, Wildlife Management,* and *Forest Recreation* are terms which should be self-explanatory.

Degrees Granted

During the calendar year 1957 the 37 schools of forestry awarded an estimated 1,174 undergraduate

degrees, 223 master degrees, and 48 doctor degrees. Of the undergraduate degrees 1,068 or 91 percent were awarded by the accredited schools, compared to 800 or 90 percent in 1956; 754 or 91 percent in 1955; and 858 or 90 percent in 1954.

Looking at the breakdown of the undergraduate degrees in the specialized fields, we find that 763 or 65 percent, were in the field of *General Forestry*. This compares to 68 percent in 1956; 71 percent in 1955; and 67 percent in 1954 (see Table 2).

Wood Technology and Utilization ranked second with 10 percent and *Wildlife Management* followed with 9 percent, while *Others* accounted for 12 percent, an increasing number as noted last year.

The estimated number of master degrees granted in 1957 totaled 223, a decrease of 10 from last year's 233. *General Forestry* accounted for 123 or 55 percent. *Wildlife Management* ranked second with 33 or 15 percent and *Wood Technology and Utilization* a close third with 32 or 14 percent. Of the 223 master degrees granted 220 were granted by the accredited schools (see Table 3).

TABLE 3.—MASTER DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS 1956 AND 1957

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
Alabama	--	1	---	---	---	---	---	---	---	---	---	---	---	1
California	7	9	---	---	1	1	---	---	---	---	---	---	8	10
Colorado	---	1	---	---	2	2	5	6	1	1	---	---	8	10
Duke	13	7	5	3	---	---	---	---	---	---	---	---	18	10
Florida	1	2	---	1	---	---	---	1	---	---	---	---	1	4
Georgia	7	5	---	---	---	---	1	1	---	---	---	---	8	6
Idaho	4	2	1	---	3	2	3	3	---	---	---	2	11	9
Iowa	1	1	3	1	---	---	---	---	---	---	---	---	4	2
Louisiana State	2	4	---	---	---	---	2	6	---	---	---	---	4	10
Massachusetts	---	---	---	---	---	---	1	---	---	---	---	---	1	---
Michigan State	8	10	---	---	---	---	7	5	---	---	5	11	20	26
Michigan Univ.	16	13	---	6	---	---	6	2	---	---	10	10	32	31
Minnesota	5	2	---	1	---	---	---	---	---	---	---	2	5	5
Montana	2	3	---	---	---	---	---	1	---	---	---	---	2	4
New York	17	17	12	6	---	---	---	---	---	---	9	1	38	24
North Carolina	4	3	4	2	---	---	---	---	---	---	---	---	8	5
Oregon	7	5	1	---	---	---	---	---	---	---	---	---	8	5
Pennsylvania	4	4	3	4	---	---	---	1	---	---	---	---	7	9
Purdue	4	4	3	---	---	---	---	---	---	---	---	---	7	4
Utah	5	1	---	---	1	3	5	4	---	---	---	---	11	8
Washington Univ.	5	6	---	2	---	---	---	---	---	---	---	---	5	8
Yale	22	23	2	6	---	---	---	---	---	---	---	---	24	29
Total	134	123	34	32	7	8	30	30	1	1	24	26	230	220
Schools not accredited														
New Hampshire	2	---	---	---	---	---	---	---	---	---	---	---	2	---
Virginia Poly.	---	---	---	---	---	---	1	2	---	---	---	---	1	2
Washington State	---	---	---	---	---	---	---	1	---	---	---	---	---	1
Total	2	---	---	---	---	---	1	3	---	---	---	---	3	3
Grand total	136	123	34	32	7	8	31	33	1	1	24	26	233	223

TABLE 4.—DOCTOR DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS 1956 AND 1957

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
California	1	1	---	---	1	---	---	---	---	---	2	---	4	1
Duke	2	3	---	---	---	---	---	---	---	---	---	---	2	3
Iowa	1	1	---	---	---	---	---	---	---	---	---	---	1	1
Michigan State	4	4	---	---	---	---	2	3	---	---	---	---	6	7
Michigan Univ.	---	2	1	---	---	---	1	1	---	---	1	4	3	7
Minnesota	---	1	---	1	---	---	---	---	---	---	---	1	---	3
New York	2	8	7	7	---	---	---	---	---	---	---	---	9	15
Utah	---	---	---	---	1	1	1	---	---	---	---	---	2	1
Washington Univ.	2	---	1	---	---	---	---	---	1	---	---	---	4	---
Yale	2	6	---	4	---	---	---	---	---	---	---	---	2	10
Total	14	26	9	12	2	1	4	4	1	---	3	5	33	48
Schools not accredited														
Virginia Poly.	---	---	---	---	---	---	1	---	---	---	---	---	1	---
Grand total	14	26	9	12	2	1	5	4	1	---	3	5	34	48

The estimated number of doctor degrees granted this year increased from 34 in 1956 to 48, which is the largest number granted in any one year. The next highest number was granted in 1954 and totaled 44. The majority (54 percent) were in *General Forestry* and all were granted by nine accredited schools with New York and Yale accounting for 25 (see Table 4).

Undergraduate Enrollment

After an all time high of 8,212 in the fall of 1948, undergraduate enrollment dropped to 4,691 in 1952. Since that date it has increased, and totaled 7,395 this year.

TABLE 5.—ENROLLMENT BY CLASSES AT SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE FALL TERM 1957-1958

Accredited schools	Freshmen	Sophomore	Junior	Senior	Total undergraduate	Graduates: Master	Graduates: Doctor
Alabama	53	45	39	17	154	4	—
California	17	27	43	38	125	17	17
Colorado	180	141	97	106	524	23	—
Duke	—	—	—	—	—	32	6
Florida	45	30	16	22	113	2	—
Georgia	76	74	59	80	289	6	—
Idaho	71	69	63	58	261	21	—
Iowa	74	56	46	43	219	7	3
Louisiana Polytechnic Inst.	60	21	21	24	126	—	—
Louisiana State	50	12	34	30	126	16	—
Maine	89	62	53	50	254	5	—
Massachusetts	22	23	28	14	87	8	—
Michigan Mining	43	27	22	21	113	—	—
Michigan State	174	173	234	156	737	60	24
Michigan University	23	26	46	50	145	36	35
Minnesota	100	99	72	51	322	24	10
Missouri	38	40	41	36	155	3	—
Montana	98	67	86	67	318	9	—
New York	155	125	122	106	508	58	34
North Carolina	79	82	67	55	283	17	3
Oregon	79	91	93	90	353	19	—
Pennsylvania	121	81	62	76	340	15	—
Purdue	38	44	38	36	156	6	1
Utah	129	85	101	58	373	41	18
Washington University	77	70	69	55	271	19	10
West Virginia	63	65	34	40	202	—	—
Yale	—	—	—	—	—	39	13
Total	1,954	1,635	1,586	1,379	6,554	487	174
Schools not accredited							
Arkansas	54	22	19	22	117	—	—
Connecticut	9	19	13	19	60	—	—
Mississippi	41	45	28	41	155	—	—
New Hampshire	16	18	16	21	71	1	—
Oklahoma	37	23	30	39	129	—	—
Rutgers	15	7	12	4	38	—	—
Texas (S.F. Austin)	32	18	12	11	73	—	—
University of the South	15	10	6	4	35	—	—
Virginia Polytechnic Inst.	31	12	7	7	57	5	4
Washington State	26	22	30	28	106	7	1
Total	276	196	173	196	841	13	5
Grand total	2,230	1,831	1,759	1,575	7,395	500	179

TABLE 6.—UNDERGRADUATE FALL TERM ENROLLMENTS BY CLASSES IN SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE YEARS 1944-1945 THROUGH 1957-1958

Academic years	Freshmen: Enrollment	Freshmen: Change	Sophomores: Enrollment	Sophomores: Change	Juniors: Enrollment	Juniors: Change	Seniors: Enrollment	Seniors: Change	Totals: Enrollment	Totals: Change
1944-1945	321	+ 122	114	+ 20	64	— 37	72	— 37	571	+ 68
1945-1946	840	+ 519	315	+ 201	205	+ 141	113	+ 41	1,473	+ 902
1946-1947	3,611	+2,771	1,840	+1,525	914	+ 709	645	+ 532	7,010	+5,537
1947-1948	2,061	—1,550	2,878	+1,038	1,577	+ 663	938	+ 293	7,454	+ 444
1948-1949	1,851	— 210	2,178	— 700	2,497	+ 920	1,686	+ 748	8,212	+ 758
1949-1950	1,485	— 366	1,667	— 511	1,816	— 681	2,501	+ 815	7,469	— 743
1950-1951	1,442	— 43	1,379	— 288	1,384	— 432	1,730	— 771	5,935	—1,534
1951-1952	1,370	— 72	1,107	— 272	1,053	— 331	1,269	— 461	4,799	—1,136
1952-1953	1,536	+ 166	1,012	— 95	1,013	— 40	1,130	— 139	4,691	— 108
1953-1954	1,698	+ 162	1,168	+ 156	917	— 96	1,126	— 4	4,909	+ 218
1954-1955	1,986	+ 288	1,377	+ 209	1,032	+ 115	962	— 164	5,357	+ 448
1955-1956	2,149	+ 163	1,566	+ 189	1,236	+ 204	1,087	+ 125	6,038	+ 681
1956-1957	2,220	+ 71	1,807	+ 241	1,549	+ 313	1,357	+ 270	6,933	+ 895
1957-1958	2,230	+ 10	1,831	+ 24	1,759	+ 210	1,575	+ 218	7,395	+ 462

TABLE 7.—ENROLLMENT OF JUNIOR AND SENIOR STUDENTS IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE FALL TERM 1957-1958

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	Jr.	Sr.	Jr.	Sr.	Jr.	Sr.	Jr.	Sr.	Jr.	Sr.	Jr.	Sr.	Jr.	Sr.
Alabama	38	16	1	1	—	—	—	—	—	—	—	—	39	17
California	39	38	—	—	4	—	—	—	—	—	—	—	43	38
Colorado	20	29	6	9	9	23	22	28	10	12	30	5	97	106
Florida	14	19	1	—	—	—	1	3	—	—	—	—	16	22
Georgia	51	77	—	—	—	—	8	3	—	—	—	—	59	80
Idaho	37	39	4	6	8	6	7	3	—	—	7	4	63	58
Iowa	33	33	13	6	—	4	—	—	—	—	—	—	46	43
Louisiana Poly. Inst.	21	24	—	—	—	—	—	—	—	—	—	—	21	24
Louisiana State	34	30	—	—	—	—	—	—	—	—	—	—	34	30
Maine	43	41	—	—	—	—	10	9	—	—	—	—	53	50
Massachusetts	16	10	—	—	—	—	12	4	—	—	—	—	28	14
Michigan Mining	22	21	—	—	—	—	—	—	—	—	—	—	22	21
Michigan State	52	39	4	2	—	—	31	15	5	5	142	95	234	156
Michigan Univ.	18	30	9	—	—	—	14	9	—	—	5	9	46	50
Minnesota	43	29	3	—	—	—	22	12	—	—	4	10	72	51
Missouri	40	30	—	—	—	—	—	—	—	—	1	6	41	36
Montana	52	46	9	9	10	6	8	4	7	1	—	1	86	67
New York	50	44	35	27	—	—	—	—	—	—	37	35	122	106
North Carolina	40	33	12	9	—	—	—	—	—	—	15	13	67	55
Oregon	78	75	15	15	—	—	—	—	—	—	—	—	93	90
Pennsylvania	54	69	8	7	—	—	—	—	—	—	—	—	62	76
Purdue	33	31	5	5	—	—	—	—	—	—	—	—	38	36
Utah	40	21	—	—	19	21	36	16	6	—	—	—	101	58
Washington Univ.	61	42	8	13	—	—	—	—	—	—	—	—	69	55
West Virginia	25	25	7	8	—	—	2	7	—	—	—	—	34	40
Total	954	891	140	119	50	60	173	113	28	18	241	178	1,586	1,379
Schools not accredited														
Arkansas	19	22	—	—	—	—	—	—	—	—	—	—	19	22
Connecticut	9	12	—	—	—	—	4	7	—	—	—	—	13	19
Mississippi	28	41	—	—	—	—	—	—	—	—	—	—	28	41
New Hampshire	11	13	—	—	—	—	5	8	—	—	—	—	16	21
Oklahoma	30	39	—	—	—	—	—	—	—	—	—	—	30	39
Rutgers	12	4	—	—	—	—	—	—	—	—	—	—	12	4
Texas (S.E. Austin)	12	11	—	—	—	—	—	—	—	—	—	—	12	11
Univ. of South	6	4	—	—	—	—	—	—	—	—	—	—	6	4
Virginia Poly. Inst.	7	7	—	—	—	—	—	—	—	—	—	—	7	7
Washington State	20	17	—	—	3	2	7	9	—	—	—	—	30	28
Total	154	170	—	—	3	2	16	24	—	—	—	—	173	196
Grand total	1,108	1,061	140	119	53	62	189	137	28	18	241	178	1,759	1,575

However, the total increase this year is only 462 compared to 895 last year and 681 the year before (see Tables 5 and 6).

All classes again show an increase in enrollment but, compared to last year, by a greatly reduced number. The freshman increase dropped from 71 to 10, the sophomore from 241 to 24, the junior from 313 to 210 and the senior from 270 to 218.

Looking at this breakdown by specialized curricula we find that 63 percent of the junior and 66 percent of the senior enrollment was accounted for by those majoring in *General Forestry* (see Table 7). These precentages are approximately the same as they have been for the past several years. In other words, approximately two-thirds of the undergraduate enrollment continues in *General Forestry*. It would also indicate that the bachelor degrees granted during the next two years will continue to account for two-thirds of the total, as it has for the past five years.

TABLE 8.—FALL TERM ENROLLMENT OF WOMEN IN SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE YEARS 1943 THROUGH 1957

	Freshmen	Sophomore	Junior	Senior	Total undergraduates	—Graduates— Masters	Doctors
1943	2	—	1	4	7	—	—
1944	5	5	—	1	11	1	—
1945	5	6	5	—	16	1	—
1946	5	5	4	4	18	—	1
1947	1	1	3	4	9	—	—
1948	1	3	1	4	9	2	—
1949	1	1	2	2	6	1	—
1950	2	—	1	4	7	1	1
1951	—	4	—	1	5	—	1
1952	5	2	3	—	10	1	1
1953	8	5	—	3	16	—	—
1954	7	6	3	1	17	2	—
1955	4	5	6	3	18	5	1
1956	8	3	5	4	20	4	5
1957	7	4	5	4	20	4	1

Wildlife Management ranks second, as it did last year, with 10.7 percent of the junior class and 8.7 percent of the senior class. *Wood Technology and Utilization* follows with 8 and 7.5 percent in the junior and senior classes respectively. *Range Management* follows with 3 and 4 percent respectively.

Trends in enrollment are always

TABLE 9.—ENROLLMENT OF GRADUATE STUDENTS IN SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE FALL TERM 1957-58

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	Ms.	Dr.	Ms.	Dr.	Ms.	Dr.	Ms.	Dr.	Ms.	Dr.	Ms.	Dr.	Ms.	Dr.
Alabama	4	—	—	—	—	—	—	—	—	—	—	—	4	—
California	12	12	3	—	2	5	—	—	—	—	—	—	17	17
Colorado	6	—	—	—	6	—	10	—	1	—	—	—	23	—
Duke	29	2	3	2	—	2	—	—	—	—	—	—	32	6
Florida	2	—	—	—	—	—	—	—	—	—	—	—	2	—
Georgia	5	—	—	—	—	—	1	—	—	—	—	—	6	—
Idaho	8	—	2	—	3	—	6	—	—	—	2	—	21	—
Iowa	4	3	3	—	—	—	—	—	—	—	—	—	7	3
Louisiana State Univ.	14	—	—	—	—	—	2	—	—	—	—	—	16	—
Maine	2	—	—	—	—	—	—	—	—	—	—	—	5	—
Massachusetts	—	—	—	—	—	—	8	—	—	—	—	—	8	—
Michigan State	14	12	5	2	—	—	21	8	2	—	18	2	60	24
Michigan Univ.	14	12	2	1	—	—	11	3	—	—	9	19	36	35
Minnesota	14	6	4	1	—	—	1	1	—	—	5	2	24	10
Missouri	3	—	—	—	—	—	—	—	—	—	—	—	3	—
Montana	2	—	3	—	2	—	2	—	—	—	—	—	9	—
New York	29	11	21	23	—	—	—	—	—	—	8	—	58	34
North Carolina	10	—	7	3	—	—	—	—	—	—	—	—	17	3
Oregon	14	—	5	—	—	—	—	—	—	—	—	—	19	—
Pennsylvania	7	—	5	—	—	—	3	—	—	—	—	—	15	—
Purdue	3	—	—	—	—	—	2	1	—	—	1	—	6	1
Utah	7	—	—	—	14	8	20	10	—	—	—	—	41	18
Washington Univ.	15	10	4	—	—	—	—	—	—	—	—	—	19	10
Yale	35	10	4	3	—	—	—	—	—	—	—	—	39	13
Total	253	78	71	35	27	15	90	23	3	—	43	23	487	174
Schools not accredited														
New Hampshire	1	—	—	—	—	—	—	—	—	—	—	—	1	—
Virginia Poly. Inst.	—	—	—	—	—	—	5	4	—	—	—	—	5	4
Washington State	—	—	—	—	—	—	7	1	—	—	—	—	7	1
Total	1	—	—	—	—	—	12	5	—	—	—	—	13	5
Grand total	254	78	71	35	27	15	102	28	3	—	43	23	500	179

TABLE 10.—NUMBER OF DEGREES GRANTED FOR COMPLETION OF STUDIES AT SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE CALENDAR YEARS 1900-1957

Years	Undergraduate degrees	Master's degrees	Doctor's degrees
1900	1	—	
1901	5	—	
1902	2	9	
1903	3	14	
1904	9	29	
1905	9	34	
1906	24	24	
1907	19	27	
1908	31	35	
1909	47	44	
1910	61	48	
1911	100	61	
1912	122	54	
1913	136	37	
1914	151	42	
1915	124	35	
1916	151	36	
1917	160	27	
1918	65	10	
1919	53	6	
1920	160	25	
1921	126	26	
1922	141	44	
1923	217	31	
1924	215	43	
1925	280	44	
1926	259	58	
1927	263	50	
1928	302	64	
1929	291	54	
1930	308	69	
1931	394	97	(34)[1]
1932	380	78	7
1933	355	65	6
1934	337	47	6
1935	423	58	8
1936	502	67	9
1937	803	75	7
1938	980	95	5
1939	1,102	112	8
1940	1,072	105	9
1941	834	117	12
1942	654	76	13
1943	446	28	6
1944	106	12	3
1945	51	18	7
1946	192	65	8
1947	553	223	7
1948	918	222	16
1949	1,443	205	12
1950	2,321	275	29
1951	1,564	267	21
1952	1,267	226	25
1953	1,045	151	37
1954	957	179	44
1955	829	194	31
1956	887	233	34
1957	1,174	223	48
Total	25,424	4,593	452

[1]Total doctor's degrees granted prior to 1932. Break-down by years not available.

confused by many factors and predictions are hazardous at best. Two years ago trends indicated an increase in 1956 of 10 percent which actually totaled 15 percent. Last year the trends for this year indicated an increase of 12 percent, but the figures now show an increase of only 7 percent.

An analysis of the enrollment for the past five years shows some interesting figures. For example the sophomore class has shown an average decrease of 368 over the previous freshman class (this varied from 321 to 42). The junior class was less consistent but showed an average decrease of 87 over the previous sophomore class. The senior class has consistently shown an increase over the preceding junior class for the past six years and has averaged 52 for the past five. Using these averages together with present enrollment figures and assuming a freshman enrollment approximating that of this year; next year's enrollment should total, in round numbers, 7,400. This would

be a net increase of 3 percent.

The enrollment of undergraduate women students continues small, totalling 20 both this year and last, 18 the year before, and 17 the year before that (see Table 8).

Graduate Enrollment

The graduate enrollment is confined to 24 accredited and 3 non-accredited schools, as it was last year. The enrollment for the master degree has increased from 430 to 500, and the doctorate from 165 to 179 or a combined increase from 595 to 679. Of these 49 percent are in *General Forestry;* 19 percent in *Wildlife Management;* and 16 percent in *Wood Technology and Utilization.* The accredited schools account for 487 of the 500 master candidates and 174 of the 179 doctor candidates.

Among the accredited schools 253 of the 487 master candidates were enrolled in *General Forestry,* 90 in *Wildlife Management,* and 71 in *Wood Technology and Utilization.* Among the non-accredited schools out of a total of 13 candidates, 12 were in *Wildlife Management,* and 1 in *General Forestry* (see Table 9).

The enrollment for the doctorate in the accredited schools shows 78 in *General Forestry,* 35 in *Wood Technology and Utilization,* and 28 in *Wildlife Management* (see Table 9).

Of the 679 graduate students enrolled throughout the nation only 5 are women, 4 candidates for the master degree and 1 for the doctorate (see Table 8).

Response of Six Conifers in North Mississippi Underplantings

Hamlin L. Williston and Bernard J. Huckenpahler
Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

DECADES OF OVERCUTTING and uncontrolled fires have left northern Mississippi with more than 300,000 acres of upper slopes and ridges that are sparsely stocked with such low-value species as blackjack oak (*Quercus marilandica* Muenchh.) and post oak (*Q. stellata* Wangenh.). Similar conditions exist in western Tennessee.

These dry sites generally will not grow more valuable hardwood species to merchantable size and quality in reasonable time. Conifers, especially pines, appear better adapted. Since an adequate source of pine seed is usually lacking, planting is an obvious alternative. The problem is to determine which conifer will survive and grow best when underplanted in the low-grade hardwood stands.

The Experiment

In the planting season of 1948-49, a study was established on the Tallahatchie Experimental Forest near Oxford, Mississippi, to determine and to compare the survival and growth of shortleaf pine (*Pinus echinata* Mill.), loblolly pine (*Pinus taeda* L.), longleaf pine (*Pinus palustris* Mill.), slash pine (*Pinus elliottii* Engelm.), Virginia pine (*Pinus virginiana* Mill.), and eastern redcedar (*Juniperus virginiana* L.). All six conifers were underplanted in low-grade upland hardwood stands, with and without release.

Sixteen plots, each containing six species subplots, were located on ridges and upper slopes. Cover on these sites was predominantly blackjack oak, post oak, and hickory (*Carya* sp.) averaging 64 square feet of basal area per acre in trees of sapling size and larger. Each species subplot was 66 feet square or one-tenth of an acre in area. Some of these subplots were on Lexington silt loam soil of loessial origin and some were on Ruston sandy loam, a Coastal Plain soil.

Each year, for four consecutive

FIG. 1.—Loblolly pines four years after planting on a ridge formerly stocked with blackjack and post oak.

TABLE 1.—AVERAGE SURVIVAL AND HEIGHT OF FIVE-YEAR-OLD CONIFEROUS PLANTATIONS

Species	Survival		Height	
	Released	Unreleased	Released	Unreleased
	Percent		*Feet*	
Loblolly pine	56	46	8.0	3.1
Shortleaf pine	54	51	4.9	1.8
Virginia pine	53	60	6.2	2.9
Slash pine	18	20	6.2	2.0
Longleaf pine	10	7	1.1	.1
Eastern redcedar	66	70	2.6	.9

years beginning in 1949, four randomly selected plots were planted in February. Seedlings were set at an 8- by 8-foot spacing in order to eliminate the possibility of early crowding. Sixty-four seedlings were planted on each subplot. During the four years, a grand total of 1,024 seedlings of each species was planted. The overstory hardwoods on half of the plots were girdled and poisoned just before the pines were planted. Sprouts and other competing vegetation subsequently developing were cut back annually where necessary.

Survival and Height Growth

Seedling survival on all four replications was recorded at the end of the growing season annually for five years and total height of the interior 36 seedlings in each subplot for the last four years. Damage to the seedlings by insects, animals, and falling debris was recorded at the time of each inventory. The analysis of the data discussed below is based upon the averages of all four years of planting.

First-year survival of released redcedar was 88 percent, that of released loblolly and shortleaf pine 76 percent, that of Virginia pine 68 percent, and that of slash and longleaf pine 52 percent and 50 percent respectively. Release substantially increased the initial survival of only slash and longleaf pines (Fig. 1).

An analysis of variance of seedling survival five years after planting (Table 1) determined that differences in survival among species were highly significant. Survival of redcedar was best, that of loblolly, shortleaf, and Virginia pine fair, that of slash pine poor, and that of longleaf pine very poor. The interaction between species and year of planting was also highly significant—probably because of the effect on some species of the unusually dry growing seasons of 1952, 1954, and 1956. Loblolly pine, for example, survived less well when planted in dry than in favorable years. Of the redcedar seedlings, those planted in the dry years had best survival, possibly because they were of superior physiological quality.

Differences in survival due to year of planting and to treatment were not significant. The interactions between year of planting and treatment, between species and treatment, and between species, treatment, and year of planting were also not significant. In general, the effect of the overwood competition on survival has not yet made itself felt.

Height growth of all species was greatly stimulated by release from overstory competition (Table 1). After five years, seedlings on the released plots were almost three times as tall as those on the unreleased plots. With release the height growth of loblolly pine was excellent, that of Virginia and slash pine good, and that of shortleaf pine fair.

Differences in height development due to treatment and to species were, as expected, highly significant. The interaction between year of planting and treatment was not significant. The interaction between species and year of planting, between species and treatment, and between species and treatment and year of planting were all highly significant.

Discussion

The results of the first five years of this study must be viewed with respect to weather, soil type, insect damage, and animal damage.

Rainfall.—Normal annual rainfall for this area is 53 inches, with 30 inches falling during the March-through-September growing season. Rainfall during the growing season in 1949 and 1951 was approximately normal. The summer of 1950 was unusually wet and the summers of 1952 and 1954 were unusually dry—the driest since 1889. In 1953, the spring months were very wet and the summer, dry. The year 1955 had a wet spring and a wet July while rainfall during 1956 fell below normal after May.

Marked as the differences in annual and seasonal rainfall are, their effect on seedling survival is not distinct. The first year following planting is generally considered to be the critical one. Yet overall survival of the seedlings planted in 1950, a very wet year, did not differ radically from the survival of those planted in 1949 or 1951, years of nearly normal rainfall, or of those planted in 1952, a very dry year. Indeed, after five years, overall survival of those trees planted in 1950, the very wet year, was poorest. Weather conditions doubtless contributed to mortality but their effect on mortality appears to have been most pronounced in combination with other factors.

Soil type.—One-third of the plots were planted on Ruston soil, a deep sandy loam with fairly rapid internal drainage. All other plots were on Lexington soils, which have a greater water-holding capacity. Survival, in general, has been better on Lexington soils. On Ruston soils during drought years both shortleaf and Virginia pine have shown better survival but poorer height growth than loblolly pine. Redcedar has shown good survival on both Lexington silt loam and Ruston sandy loam soils. Survival of slash pine, while not good, has been better on the Lexington soils.

Insect damage.—Tip-moth (*Rhyacionia frustrana* [Comst.]) attack on released pine seedlings increased from an average of 29 percent on one-year-old plantations to 63 percent on two-year-old plantations, and to 86 percent on five-year-old plantations. After the fifth growing season 98 percent of the loblolly, 98 percent of the Virginia, 88 percent of the shortleaf, and only 2 percent of the slash pine seedlings were infested with tip moth.

During the first year many of the terminal buds and twigs are too small in diameter to harbor tip-moth larvae and many of the seedlings are hidden by grass and brush. During the five-year study period only slash pine has become less susceptible to attack with increasing age. Attack on this species during the third, fourth, and fifth years has been confined primarily to branch tips. Infestation on unreleased seedlings, though less heavy than on the released, has also increased steadily throughout the five-year period.

Webworm (*Tetralopha robustella* Zell.) attack on the released seedlings decreased after the first year as the seedlings became less shaded by the deadened overstory and the surrounding ground cover. Attack on second-year released seedlings seemed to be confined mostly to the shaded lower needles. Webworm attack on unreleased seedlings increased from 13 percent on one-year seedlings to 20 percent on two-year seedlings but fell off to 7 percent on the five-year-old plantations.

Although the incidence of tip-moth attack on the released seedlings is much higher and the damage more noticeable than that of webworm, the tip-moth has not caused any mortality, and the trees will become less susceptible as they grow taller. Webworm defoliation, on the other hand, killed some of the young seedlings, especially on unreleased plots. Fortunately, webworm damage can be reduced by early release.

Animal damage.—Deer have repeatedly browsed the planted redcedar, apparently preferring it to native redcedar. During the fifth year deer browsed 45 percent of the released trees and 35 percent of the unreleased. At one time or another, all redcedar seedlings have been browsed to the detriment of their growth. On the unreleased plots repeated browsing has caused some mortality.

Conclusions

In north Mississippi, fifth-year results of four consecutive years of underplanting ridge hardwoods with six conifers show that immediate release from hardwood competition greatly stimulates the height growth of seedlings. Seedlings on the released plots are almost three times as tall as those on unreleased plots. Release slightly improved the survival of loblolly, shortleaf, and longleaf pine.

Loblolly pine appears to be the best of six species tested for restocking depleted hardwood stands on dry loessial ridges. When released, it has survived as well as shortleaf and Virginia pines and nearly as well as eastern redcedar, and has substantially outgrown all three during the first five years.

On ridges of Ruston sandy loam, shortleaf pine has survived better than loblolly pine during drought years and may be preferable to loblolly on severely eroded areas where site protection is of paramount importance. Where timber production is the primary consideration, loblolly's faster height growth and ability to overcome tip-moth damage makes it the preferred species.

Virginia pine has also survived better than loblolly pine on droughty sites. Its dense foliage and low, spreading habit provide good site protection. In the present study, at least, these good qualities are offset by extreme limbiness, which makes the Virginia pine look less desirable than loblolly, even for pulpwood. The poor form, however, may have resulted from the particular source of seed involved.

Slash and longleaf pines, because of their poor survival and known susceptibility to ice damage, are not recommended for planting in north Mississippi.

Redcedar has shown good survival on both Lexington silt loam and Ruston sandy loam soils but has been severely browsed by deer. Where deer populations are light and where soil rebuilding is an important consideration, redcedar should do well.

Notes

Effect of Grazing on Fertility of Farm Woodlot Soils in Southern Wisconsin[1]

The damage to farm woodlots by heavy grazing, including removal of reproduction and ground cover, and destruction of the layer of leaf litter, have long been recognized (*3, 4*). Investigations of the influence of grazing on soils supporting farm woodlands has been primarily concerned with the physical properties, such as permeability of soil to moisture and air, and dangers of accelerated erosion on steep slopes (*5*). Chandler (*2*) and Steinbrenner (*7*) reported on the alteration of soil physical properties, including deceased organic matter content, total pore space and water stable aggregates, and increased volume weight and surface temperature of grazed areas.

Ideas pertaining to woodland pasturing in the Lake States region have been aptly summarized by Ahlgren et al. (*1*): "Continued grazing of wooded areas on gray-brown podzolic soils in the northern part of the Mississippi Valley cannot be recommended either from the standpoint of economical forage production or efficient land use."

The influence of grazing on the fertility of soils supporting the hardwood stands has been largely neglected. This paper presents several illustrations of the appraisal of fertility of soils in adjacent pairs of grazed and ungrazed woodlands by soil and litter analyses.

Description of Areas

Samples of freshly fallen leaves and soil were collected in four pairs of adjacent grazed and ungrazed farm woodlots in southern Wisconson. These woodlands were previously investigated by Steinbrenner (*7*). His description of soils and stands follows:

Champion Valley timber harvest forest and Borton farm woodland (Driftless area of southwestern Wisconsin).—Hard maple with some basswood, red oak, and American elm, 125 years old, on nut-structured soil derived from loess (Dubuque silt loam).

Spring Grove woodland (Unglaciated area of southern Wisconsin).—Hard maple with some basswood, red oak, and American elm, from 125 to 200 years old, on prairie-like nut-structured soil underlain by limestone (Downs silt loam).

Albany woodland (Border of the unglaciated area of southern Wisconsin).—White oak, red oak, and butternut, 110 years old, on heavy soil derived from residual limestone overlain by loess (Fayette silt loam).

Each pair of woodlots has similar soil types, gradient and exposure, and originally had similar forest cover.

Methods of Analyses

Samples of freshly fallen leaves were collected in two foot square wire screen traps, placed on the ground surface in representative portions of hardwood stands. The careful location of the traps was necessary to get a representative sample, considering both the overall composition of the stand and the spread of the crowns. The collection extended from the middle of September to the middle of October. In every case litter was collected as soon as possible after it dropped from the trees to minimize errors due to decomposition and leaching of the foliage (*6*).

A composite of litter from four traps per stand was dried at 70° C. immediately after collection, weighed, and ground in a Wiley mill. The laboratory analysis of the tissue included reaction, and contents of ash, nitrogen, phosphorus, potassium, calcium, and magnesium. The surface six inches depth of soil near each wire screen trap was sampled for physical and chemical analyses (*8*).

Results of Analyses

Analyses of soils from adjacent stands reveal pronounced differences in their fertility, particularly

TABLE 1.—FERTILITY OF SOILS SUPPORTING HARDWOOD STANDS OF DIFFERENT HISTORY AND SITE QUALITY IN SOUTHERN AND NORTHERN WISCONSIN (SAMPLES COLLECTED FROM SURFACE 6 INCH LAYER)

Woodlands	Reaction pH	Organic matter	Avail. P	Exch. K	Exch. Ca	Exch. Mg
		Percent	*Pounds/Acre*		*Me./100g.*	
Albany Woods						
Ungrazed	5.7	2.2	69	297	5.50	1.85
Grazed	5.4	2.1	48	166	5.45	1.73
Spring Grove						
Ungrazed	6.5	4.3	64	269	15.70	3.15
Grazed	5.7	2.8	71	186	9.05	3.05
Borton Farm						
Ungrazed	6.2	2.9	28	287	2.50	2.88
Grazed	6.0	2.4	37	179	1.80	1.83
Champion Valley						
Ungrazed	6.3	4.4	92	315	4.30	2.39
Grazed	5.9	2.1	55	172	1.45	0.56

[1]Contribution of the Soils Department, University of Wisconsin, in cooperation with the Wisconsin State Conservation Department.

TABLE 2.—COMPOSITION OF LITTER OF GRAZED AND UNGRAZED 125 YEAR OLD STANDS OF HARD MAPLE AND ASSOCIATED HARDWOODS ON A NUT-STRUCTURED SILT LOAM, DUBUQUE SERIES (CHAMPION VALLEY TIMBER HARVEST FOREST, SOUTHWESTERN WISCONSIN)

Time of litter collection	Weight of litter	Reaction pH	Ash	N	P	K	Ca	Mg
Ungrazed woodland	*Lbs./acre*		*Percent/pounds per acre*					
1951	3,882	4.2	11.0	0.86	0.19	0.77	1.64	0.32
			428.6	33.38	7.61	29.89	63.66	12.42
1952	3,047	4.6	11.1	0.74	0.08	0.80	1.81	0.28
			338.2	22.42	2.56	24.38	55.15	8.50
1953	4,087	4.7	10.3	0.87	0.10	0.39	1.59	0.30
			420.1	35.47	4.25	15.94	64.98	12.34
Grazed woodland								
1951	1,414	4.2	9.2	0.54	0.22	0.42	1.25	0.30
			129.8	7.60	3.05	5.93	17.67	4.27
1952	1,550	4.5	11.1	0.71	0.14	0.61	1.46	0.28
			171.4	10.97	2.23	9.42	22.63	4.32
1953	1,068	4.3	9.6	0.71	0.09	0.25	1.25	0.22
			102.9	7.63	1.02	2.67	13.35	2.39

TABLE 3.—COMPOSITION OF FOREST LITTER OF HARDWOOD STANDS OF DIFFERENT HISTORY AND SITE QUALITY IN SOUTHERN WISCONSIN, COLLECTED IN 1953

Woodlands	Weight of litter	Reaction pH	Ash	N	P	K	Ca	Mg
Albany Woods	*Lbs./acre*		*Pounds per acre*					
Ungrazed	2,676	4.8	264	19.7	3.2	11.9	43.3	9.7
Grazed	2,448	4.4	137	15.4	1.8	8.5	23.9	6.2
Spring Grove								
Ungrazed	3,209	5.2	412	31.5	4.8	18.9	68.7	16.3
Grazed	2,196	5.1	266	17.4	1.7	7.0	47.0	11.4
Borton Farm								
Ungrazed	4,824	4.7	576	60.9	7.2	25.6	106.1	17.6
Grazed	2,304	4.5	223	16.8	1.4	8.2	41.7	6.7
Champion Valley								
Ungrazed	4,397	4.7	420	35.5	4.2	15.9	64.9	12.3
Grazed	1,068	4.3	103	7.6	1.0	2.7	13.3	2.4

as regards the content of organic matter and exchangeable bases (Table 1). The results of available phosphorus determination are erratic.

The results of litter analysis from one pair of adjacent stands, conducted over a three year period, reveal great annual variation, undoubtedly caused by the differences in rainfall and other climatic factors (Table 2). For example, the concentration of potassium in the litter in 1952 and 1953 exhibits a variation as great as 243 percent in the grazed area. Therefore, the results of litter analysis may provide an index of the relative soil fertility levels only when such analyses are conducted on samples collected during the end of the same growing season. With this qualification the results of analyses show pronounced differences in the concentrations of ash, nitrogen, and bases in the litter of grazed and ungrazed woodlots.

Collection of litter and determination of its actual weight makes possible the expression of the nutrient content of litter in pounds per acre. This provides a truer picture of the actual supply of nutrients extracted from soil by trees. The 1951 phosphorus concentration in the grazed area is greater than that on the ungrazed area (Table 2). When expressed on a pounds per acre basis, however, the phosphorus content is twice as great in the ungrazed area.

Table 3 presents results of analyses of litter in pounds per acre in all woodlots studied. Without exception, the weight of litter, and contents of ash and nutrients in the ungrazed stands are appreciably higher than those in the grazed areas.

The results of this study indicate that grazing appreciably reduces the fertility level of the surface soil layers which serve as seed beds for natural reproduction. This is probably because the loss of nutrients caused by the removal of forage and leaching is not balanced by the return of nutrient elements from the deep soil horizons. Grazing exerts a profound adverse effect on the chemical properties of forested soils.

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ALBERT L. LEAF[2]
State University of New York
College of Forestry
at Syracuse University

[2]Study conducted while author was a research assistant in Soils, University of Wisconsin. Appreciation is expressed for helpful suggestions and advice rendered by Dr. S. A. Wilde.

Response of Southern Red Oak to Seasonal Applications of 2,4,5-T

Past experimentation has proved that the season at which southern red oaks (*Quercus falcata* Michx.) are girdled affects the rapidity of kill and the incidence of sprouting.[1] With the advent of 2,4,5-T and similar herbicides, foresters have asked if any advantage is to be gained by applying chemicals at a particular season. A 3-year study of this subject was recently concluded at the Crossett Experimental Forest[2] in south Arkansas.

Method

The study was conducted on 12 one-quarter acre plots in a shortleaf-loblolly pine-hardwood stand. Hardwoods on three plots at a time were treated in each of the seasons as follows: fall (November 1952), winter (February 1953), spring (May 1953), and summer (August 1953). In every case, treatment was appllied during the first week of the month.

The boles of all hardwoods 4 inches and larger in d.b.h. were completely encircled with a one-hack frill. Frills were made with an ax at about 3 feet above the ground, the strokes being made forcefully enough to drive the bit through the bark and cambium and a slight distance into the wood. A 1-percent water mixture (by volume) of 2,4,5-T was poured into each frill immediately after it was cut. Frills were flooded to capacity, and only one application was made per tree. The 2,4,5-T was a commercial formulation of the low-volatile esters which contained 4 pounds acid equivalent per gallon of concentrate.

Data were obtained from southern red oaks exclusively, as only this species was numerous enough to permit statistical analysis of the results. Observations on mortality, incidence of sprouting, and size and number of stems per sprout clump were made annually for three years. Tree crowns were classified as dead when they had no green foliage.

Mortality

Figure 1 shows the proportion of trees with dead crowns one, two, and three years after treatment. All trees treated in either spring or summer had dead crowns after one year. The kill was very rapid. Ninety-two percent of the trees which received the spring treatment were dead within five months. Forty percent of those treated in summer were dead after two months.

The fall and winter treatments took effect more slowly; less than half of the crowns were dead after 1 year. Mortality continued, however, so that at the end of the second year 100 percent of the trees treated in the winter and 91 percent of those treated in the fall had succumbed. Crowns of all surviving trees were considerably damaged. During the third year the crowns of the remaining 9 per-

[1]Grano, Charles X. Behavior of south Arkansas oaks girdled in different seasons. Jour. Forestry 53: 886-888, illus. 1955.

[2]Maintained in cooperation with The Crossett Company.

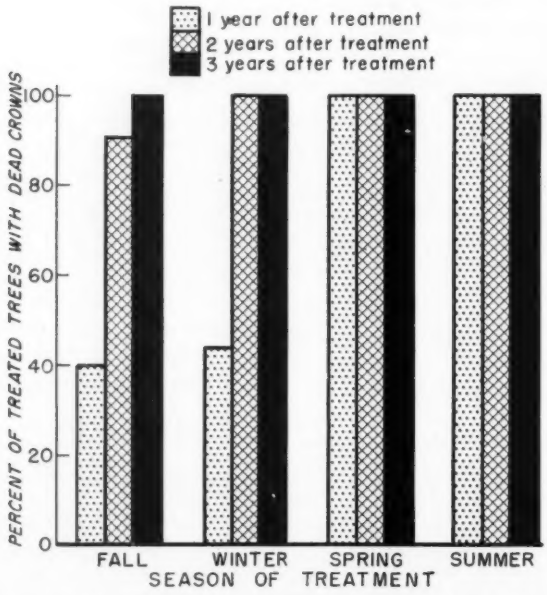

FIG. 1.—Effect of season of frilling and 2,4,5-T application on crown mortality of southern red oak.

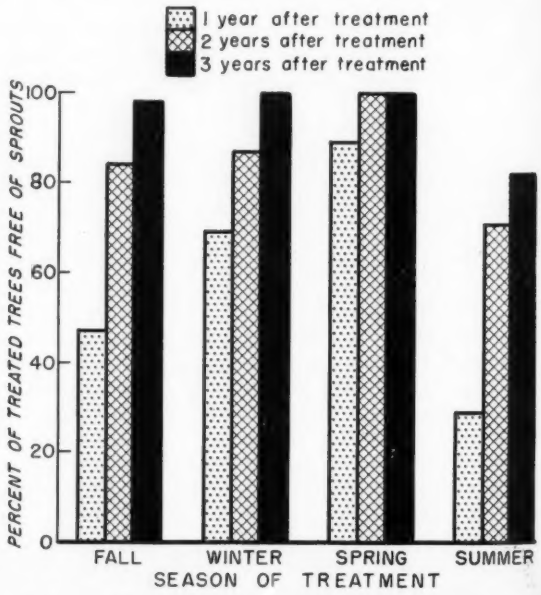

FIG. 2.—Effect of season of frilling and 2,4,5-T application on the sprouting of southern red oak.

cent of the fall-treated trees died. For practical purposes, all treatments can be considered to have resulted in complete crown mortality within two years.

Within the range of diameters observed, no relationship was found between tree diameter and the rate of crown kill.

Sprouting

One year after treatment, 89 percent of the trees which received the spring application were free of sprouts (Fig. 2). The percent of sprout-free trees in the other treatments was as follows: winter 69, fall 47, and summer 29. The data on first-year sprout control showed the spring treatment to be superior to the fall and summer applications to a highly significant degree, and significantly better than the winter application.

After the first year, the sprouts died off in appreciable numbers. By the end of the second year all of the spring-treated trees were free of sprouts, and most of the sprouts had also died on trees treated in fall and winter. Significant differences now existed between the spring and summer treatments only.

Sprout mortality continued into the third year to such an extent that the number of trees sprouting on the winter and fall plots was reduced almost to zero. At this time, the fall, spring, and winter treatments were better than the summer treatments to a highly significant degree. Even so, the proportion of sprout-bearing trees on the summer plots was small—about 18 percent.

Season of treatment had no bearing on either the number of sprouts produced per tree or sprout size.

Conclusions

In south Arkansas, spring application of 2,4,5-T in frills on southern red oaks produced faster crown kill and quicker and more complete sprout control than application at any other season.

Summer applications caused red oak crowns to die just as rapidly as the spring applications did, but permitted more sprouting than treatments made at any other season.

Regardless of season of application, almost all tree crowns died within 2 years.

Sprout mortality after the first year was high for all treatments. The number of trees sprouting became negligible within two or three years.

CHARLES X GRANO
Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

A Simple Pith Locator for Use With Off-Center Increment Cores

The determination of total tree age is usually based on ring counts of increment cores which ideally should pass through tree center. For several reasons the borer does not always "hit the pith," and it becomes necessary to estimate how many rings were missed. The pith locator described below takes much of the guesswork out of this estimate.

The device can best be made of clear cellulose acetate of about the same thickness and dimensions as a 12-inch ruler. Two 6-inch units of pocket-carrying size could be used in place of the 12-inch length. A series of several concentric half-circles are scribed along one edge of the rule. Each series has a common center and a uniform ring-width radius. Different series of rings have varying radial increments selected to most nearly fit the growth rings likely to be encountered in the field. In the accompanying sketch (Fig. 1), ring widths of one, two, three, and four millimeters were used. Rings can be cut with a good compass fitted with a sharp metal point. The acetate should be well scored. A small amount of black paint rubbed into the rings will then make them stand out better.

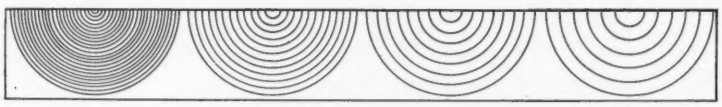

FIG. 1.—Pith locator.

In use, two steps are required. First, select the series with a ring width most nearly matching the core in question. Second, move the rule laterally until a scribed ring is superimposed over a similar ring on the core. The approximate position of the pith will thus be indicated on the rule, and the number of rings the core was "off center" can be quickly counted.

In constructing the pith locator, it is necessarily assumed that ring width will be uniform near tree center. In application this is seldom true, and will require the use of good judgment in selecting the proper series for locating the position of the pith.

M. B. APPLEQUIST
School of Forestry, Louisiana State University, Baton Rouge

Converting All-Aged Stand Tables by 1-Inch Diameter Classes to 2-Inch Classes

Have you ever tried to compare two stand tables—one tallied by 1-inch classes and the other by 2-inch classes? If you have, you probably found that it is almost impossible without first adjusting one class to conform to the other. Foresters are occasionally faced with this problem when the standards of measurement have changed with passing time.

Such was the case at the U. S. Forest Service's Fernow Experimental Forest in West Virginia. Before the fall of 1952, trees were recorded by 1-inch diameter classes. At that time, we decided that recording the trees by 2-inch classes would reduce the amount of office and field work with little or no loss in accuracy.

The new system worked fine, but the change has complicated the analysis of growth data for a series of our forest-management experiments. In order to get reliable growth estimates, especially of ingrowth, we had to adjust the original tallies by 1-inch classes to 2-inch classes. Since the method we developed is simple, accurate, and unbiased, we thought it might prove useful to others.

The method is applicable to stands having a typical all-aged development; that is, when the numbers of trees are plotted against diameter classes on semi-log graph paper, a straight line results. This characteristic of all-aged stands, known as the *law of de Liocourt*, has been fully discussed by Meyer[1] and by Meyer and Stevenson.[2] It is logical to assume that the distribution of trees within a diameter class is similar to the distribution in the entire stand.

To illustrate the method, let's take an actual example from the Fernow Forest. In 1951, a 46-acre compartment was cut to a 13.5-inch diameter limit. The numbers of trees in the residual stand were recorded by 1-inch diameter classes. The compartment was re-inventoried in 1956 by 2-inch classes. The problem is to convert the 1951 tallies to 2-inch classes.

When the numbers of trees are plotted by diameter classes on graph paper, the resulting curves (J-shaped on regular graph paper and straight line on semi-log paper) are typical of all-aged stands (Fig. 1). The quotient q between numbers of trees in successive 1-inch classes as determined from the

[1]Meyer, H. Arthur. Structure, growth, and drain in balanced uneven-aged forests. Jour. Forestry 50:85-92. 1952.

[2]Meyer, H. A., and D. D. Stevenson. The structure and growth of virgin beech, birch, maple, hemlock forests in northern Pennsylvania. Jour. Agric. Res. 67:465-484. 1943.

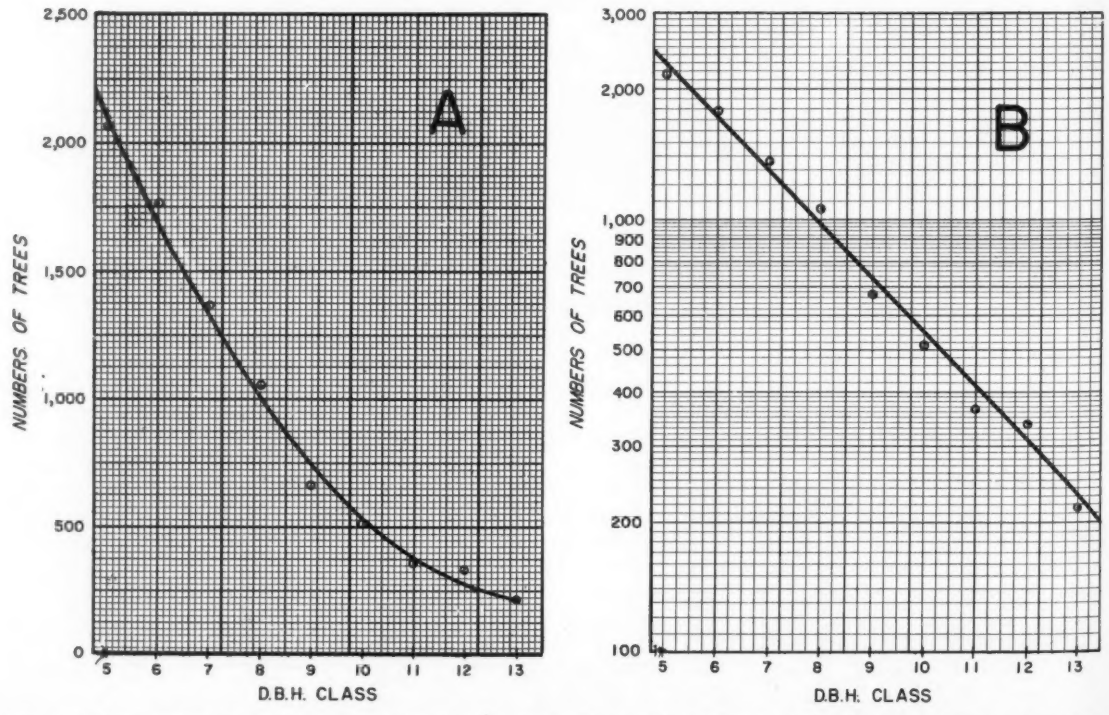

FIG. 1.—When numbers of trees are plotted by diameter classes, the resulting curves are typical of all-aged stands. *A*, plotted on regular graph paper. *B*, plotted on semi-log graph paper.

TABLE 1.—CONVERSION OF 1951 RESIDUAL STAND FROM 1-INCH D.B.H. CLASSES TO 2-INCH D.B.H. CLASSES

1-inch d.b.h. classes	D.b.h. scale	Actual tally of trees 1951	Estimated distribution		2-inch d.b.h classes
			By ½-inch classes	By 2-inch classes	
Inches	*Inches*	*Number*	*Number*	*Number*	*Inches*
	4.5		1,158		
5	5.0	2,161			
			1,003		
	5.5			3,488	6
6	6.0	1,755			
	6.5		730		
7	7.0	1,362			
			632		
	7.5			2,042	8
8	8.0	1,053			
	8.5		357		
9	9.0	666			
			309		
	9.5			1,017	10
10	10.0	513			
	10.5		195		
11	11.0	363			
			168		
	11.5			621	12
12	12.0	336			
	12.5		117		
13	13.0	219			
			102		
	13.5			102	14
14	14.0				

graph is 1.334. Therefore the q for ½-inch classes is the square root of 1.334 or 1.155. This means that within any one 1-inch diameter class (the 9-inch class, for example) there are 1.155 times as many trees in the lower half inch (8.5 inches to 9.0 inches) as in the upper half inch (9.0 to 9.5 inches). On a percentage basis then:

$$\text{Percent in upper half inch} = \frac{100}{1+q} = \frac{100}{1+1.155} = 46.4$$

This leaves 53.6 percent in the lower half of the 1-inch class. It then becomes an easy matter to apply these percentages to the trees in the old-numbered classes to come up with numbers of trees by 2-inch classes (Table 1). If we plot these numbers of trees on the semi-log paper, we find that the line is parallel to the previous one for 1-inch classes. This proves that we have retained the same structure while making the adjustment. Nevertheless, we should remember that the results are approximate rather than precise.

For even-aged or highly irregular stands, some other method, such as plotting accumulated numbers of trees, would have to be used.

RUSSELL J. HUTNIK[3]

[3]When this study was made, Mr. Hutnik was a research forester at the Mountain State Research Center, Northeastern Forest Expt. Sta., Forest Service, U. S. Dept. Agric., Elkins, W. Va. He is now on the staff of the Forestry School, Pennsylvania State University, University Park, Pa.

Correction

In the article "A study of the growth and value of a high-quality eastern white pine tree" by R. W. Foster, page 727 October, 1957, JOURNAL, the first sentence of the 4th paragraph should read in full as follows: "The annual rings of the tree indicated it came from seed in 1825."

Points of View

Comments on "Annual Variation in the Seed Crops of Loblolly Pine"

In a well-written article on a topic of great practical importance to forest managers, Wenger reported[1] that over an 8-year period in Hertford County, North Carolina, about 80 percent of the variation in annual seed crops of loblolly pine was associated with two independent variables, namely, (a) May-to-July rainfall two years prior to maturing of the cone crop, and (b) relative size of seed crop two years earlier, the crop varying directly with rainfall, but inversely with the antecedent seed crop. Wenger properly emphasizes his findings in terms of cone or seed crops, for, after all, foresters are primarily interested in the production of sound seed, insofar as this phase of management activity is concerned. Unfortunately, Wenger's emphasis leaves the impression that correlation between flower and seed production is unequivocal, i.e., failure of a cone crop results from lack of a flower crop.

All who have had occasion to closely observe flower and cone development on the same trees for a number of consecutive seasons have doubtless been impressed by the fact that good flower years occur much more frequently than good seed years. There may be various reasons why a spate of flowers disturbingly often fails to produce a spate of seed, but pests and weather are perhaps the most culpable.

As an example, in East Texas and Louisiana the cone crop in 1953 was essentially a failure. The antecedent flower crop was abundant enough, but in the fall of 1951 and in the spring of 1952 a severe infestation by an insect, working like a tip moth, hollowed out the buds (and likewise the already-formed flower primordia) of nearly every leader and main terminal of pines over a wide area. Failure of a flower crop to mature in this instance surely cannot be blamed on any failure of some "physiological rhythm" necessary to bring the tree to a condition conducive to flowering.

As another example, most foresters in the South vividly recall and ruefully recollect the widespread lack of cones in 1956. The hard, unseasonal freeze in the spring of 1955 is blamed for this failure, and correctly so. The majority of pines in that spring bore very heavy crops of flowers, but a week after the freeze, scarcely a flower could be found. The "physiological rhythm" in 1954 and 1955 was right for flowering, but cone counts and seed-trap studies would not have led to this conclusion.

The point is this: Interesting and informative as cone and seed count studies can be, they, nevertheless, do not provide a completely sound basis for formulating hypotheses about "physiological rhythms" or the condition of readiness for flowering. Current research on southern pines suggests that flower mortality, without insect control, may sometimes exceed 75 percent of the crop. Perhaps the cycles observed by Wenger, and ascribed by him in part to the retarding influence of heavy antecedent cone crops on floral differentiation, are merely insect population cycles.

It is of real practical significance to keep our thinking straight concerning the problem of flower and seed production in southern pines. We need to consider what conditions, both physiological and environmental, are optimum for flower production, and what conditions are necessary to assure that a high proportion of such flower crops will mature to sound seed. The optimum conditions for these situations are not necessarily the same, and unfortunately may complicate operations in a seed orchard or seed producing area. For example, the irrigation that may be necessary to save an immature cone crop from drought could very likely hamper the differentiation of flower buds. Nevertheless, it seems desirable to know, for example, whether the big increases in seed yield observed in connection with release result primarily from more flowers or from a higher proportion of flowers maturing to seed.

Practically speaking, as Wenger indeed implies, what foresters are interested in is the production of more seed. Is interest in flowers then merely academic conjecture? Not so. With intensification of practices, particularly in seed orchards and seed-producing areas where it may be feasible to spray for pest control, lay smoke screens to reduce frost damage, irrigate to alleviate drought conditions, *et cetera, itaque in,* we may now at least hope that we will not be completely circumscribed by periodicities or rhythms imposed by antecedent seed crops and lack of rain. Wenger has done a real service in calling our attention to his observed cycles, but before we resign ourselves to a cyclic existence, let us learn more about the interrelationships between flowering and fruiting and the practical possibilities for controlling them to our advantage.

B. J. Zobel and T. E. Maki
School of Forestry, North Carolina State College, Raleigh

[1]Wenger, Karl F. Annual variation in the seed crops of loblolly pine. Jour. Forestry 55: 567-569. 1957.

In Reply

Zobel's and Maki's interest in the paper on seed crop variations in loblolly pine is very gratifying and I appreciate the opportunity for further discussion of the subject.

That a large flower crop does not necessarily produce a large seed crop is beyond question. The possibility of large losses was emphasized in the paper and the point was made that the relation described would not apply if such losses occurred. The main question seems to be, therefore, whether such losses were a major cause of the variations in the observed crops, from which the relation was derived. In fact, Zobel and Maki suggest that ". . . the cycles . . . are merely insect population cycles."

This idea implies that flower crops were always of about the same magnitude and that losses occurred in a pattern that resulted in the observed relation of current seed crop to the seed crop and the May-to-July rainfall of two years earlier. That is, losses would have had to be positively correlated with the seed crop and negatively correlated with the May-to-July rainfall of two years earlier.

No systematic, quantitative observations of flower crops have been made in that locality, but we have noted that in some years flowers seemed to be abundant and in other years scarce. It seems very likely that flower crops vary substantially from one year to the next.

Neither do we have any information on flower and first-year cone losses, but no catastrophic losses were noted during the period in question. Some data are available on second-year cone losses, however. Observations on individual trees in southeastern Virginia in 1950 and 1951 showed that the percentage of defective cones (partially or completely destroyed) was considerably less in large crops than in small crops, ranging in both years from less than 5 percent on trees with heavy crops up to more than 70 percent on trees with very few cones. These counts included losses during most of the final season of the crop, since the defective cones were of all sizes.

This relation of cone losses to size of crop shows that the number of cones damaged did not fluctuate as widely from year to year as the total number of cones produced, so that percentage losses were smaller in the larger crops. In other words, cone losses were not the main cause of the variation in the total number of seed produced, on which the relation in question was based.

A similar pattern of losses commonly occurs with cultivated fruit and nut crops. Percentages of defective seed in the seed crops in our study also followed this trend, ranging from about 20 percent in the best crops up to 60 percent in the poorest. During the period 1936 to 1948 seed losses in the Duke Forest in the North Carolina Piedmont occurred in almost exactly the same pattern. The tendency for percentage losses to be greater in small than in large crops may, therefore, be general among fruit crops. That normal losses of flowers and first-year cones occur in the same pattern seems a definite possibility.

Additional indirect evidence that the observed variations in seed crops were not the result of losses lies in the findings of other studies of cone and seed production conducted during the same period in the same general locality. Cone production was found to be related to diameter at breast height and to prior fruitfulness, and was significantly affected by the application of fertilizer and by partial girdling. The effect of crown release on the cone production of individual trees also varied with d.b.h. and prior fruitfulness. It is extremely unlikely that these relations and effects were caused by variations in insect populations rather than by the factors and treatments specified.

Of course, catastrophic or epidemic losses can occur at any time, and it is pertinent to consider what effect such a loss may have on succeeding crops. The Tidewater Forest Research Center of the U. S. Forest Service, at Franklin, Va., with the help of the Virginia and North Carolina Divisions of Forestry, makes annual surveys and forecasts of cone crops in the coastal plain sections of the two states. Their figures show that the late, hard freeze in the spring of 1955 was much more damaging in North Carolina than in Virginia, apparently because flowering was not so far advanced in Virginia. Consequently, the 1956 cone crop was a complete failure in North Carolina. In Virginia, however, cones were present in appreciable quantities although the crop was still below average.

On the basis of the relation described in our paper, we would expect an above-average crop in 1958. First-year conelet counts of the 1958 crop, made by the Research Center in the fall of 1957, indicate a well-above-average crop in northern North Carolina and a very large crop in the southern portion, where the damage was greatest in 1955, while in Virginia the crop is average. Although these data give only a very general indication of the size of the prospective crop, it is evident that the relative size of the 1956 and 1958 crops is in accord with that indicated by the relation in question.

The use of the word "cycles" to describe the relation of the current crop to the second preceding crop was perhaps misleading. Although the suggestion of a cyclic pattern was what prompted further examination of the data, any pattern of successive crops can arise from the interaction of rainfall and size of cone crop, since a great many combinations of these two factors are possible.

The relation suggests that the physiological conditions favoring flowerbud formation are not the result of a "cycle" or "rhythm" but depend on the moisture available and the nutrient demands of the maturing crop immediately preceding and during the period of bud setting. The relation thus implies

that the requirements for cone and seed development are the same as flowerbud differentiation. Rather than "circumscribing" us, this situation suggests the possibility of producing heavy crops year after year in seed production areas and seed orchards by use of irrigation and fertilizers applied in the right amounts at critical periods.

If, on the other hand, the requirements of a maturing crop and the differentiation of flower buds were greatly different, as Zobel and Maki suggest, we would indeed be limited in seed orchard management. During the period of flowerbud differentiation, which occurs during midsummer, different stages of three successive seed crops are present: the maturing crop; the crop of the next year, present as first-year conelets; and the crop to come from the newly formed buds. With different requirements for cone development and flower-bud formation, only one full crop could be brought to maturity at a time, which means a good crop only every third year. Fortunately, the situation seems to be otherwise, for we know that at least two good crops can mature in succession without special treatment. And released trees have produced four good crops in succession.

The relation cannot be considered conclusive in any way, of course, because the data are very few and limited to a small area. It does seem to be reasonable and logical, however, and a good indication of some major factors involved in seed-crop fluctuations. As such it suggests a direction for the research that must be done before we can understand and use the processes at work. It gives us some reason to believe that irrigation alone may result in substantially larger and more regular seed crops in seed orchards and seed production areas. To anticipate complete control of flowering and fruiting is too optimistic, since it has not been achieved outdoors with any cultivated crops which have been intensively studied for many years. However, with pest control, fertilization, cultivation, and possibly other practices, in addition to irrigation, we can look forward to much larger seed crops in intensively managed seed production areas and seed orchards.

KARL F. WENGER
Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

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Reviews

Forest Nursery Practice in the Lake States

By J. H. Stoeckeler and G. W. Jones. 124 pp., illus. Agricultural Handbook No. 110, U. S. Department of Agriculture. 1957. Supt. of Documents. $2.

The authors have filled a need for a nursery handbook which answers the many questions of the new nursery operators of both county and state public nurseries and the commercial nurseries entering the field producing forest planting materials.

The section on collecting and handling tree seeds covers the information needed by beginners, and should help jar some of the older nurseries out of their lethargy. The seed makes the tree and it is high time someone has put it across to the nursery managers.

The section on "How to Select a Nursery Site" is very apropos and covers the all important factors of climate, topography, soil texture and soil fertility, vegetative cover, water supply, labor supply, transportation and communication, and source of peat and moss for the development of an ideal nursery.

The authors' long experience in nursery work have enabled them to set forth especially well the recommendations for the development of the nursery site covering the water supply and irrigation plant. This section would be strengthened by a diagram of an ideal nursery layout on a normal land subdivision area of 20, 40, or 80 acres.

Machinery, tools, and specialized equipment are well covered for the operating nurseryman but should include greater detail for the man just starting a nursery.

Occasionally the authors forget the layman has not had a forester's training. "Seedbed boards are 1-by-4 inch 12 foot boards." Should they be hardwood as I have seen in commercial nurseries which rot out in a few years? Why not tell him to use a durable conifer such as western red cedar, which often lasts 12 to 16 years in the Lake States.

Labor is the big cost item in any nursery, yet the authors pass over it very briefly in both references to labor.

The soil management section is the best published to date in any nursery handbook, yet this might have been improved by a table giving actual soil fertility practices for the many U. S. Forest Service nurseries. These nurseries are located from southern Indiana to northern Minnesota and have developed fertility programs over the years which should well illustrate good practices for the soil types in this latitude.

I like the tables for age classes of stock needed for reforestation being placed in a nurserymen's handbook because it too often has been only in the possession of the field plantation inspector. It is also very timely, for many commercial nurserymen breaking into the forest nursery stock market have little or no conception of the characteristics of quality field planting stock capable of establishing a plantation in one operation.

Seedbed preparation and sowing are adequately covered and follow up the age classes for field planting with good seedling density recommendations per square foot. Soil moisture and seedbed care are presented in a forthright manner by Stoeckeler and Jones. They also do an admirable job on protection covering the problems, causes, and treatments to correct losses from preventable causes.

The meager section on cost of tree production may well have been deleted as it tells nothing new to Forest Service nurserymen who must follow established systems, and offers no help to the nurseryman who must prepare that important report to the United States Treasury Department each April.

This is the best nursery handbook I have seen and I recommend it to all nurseries producing forest planting or lining-out stock.

P. W. ROBBINS
Michigan State University

Elementary Soil and Water Engineering

By Glenn O. Schwab, Richard K. Freuert, Kenneth K. Barnes, and Talcott W. Edminister. 296 pp. Illus. John Wiley and Sons, Inc., New York. 1957. $6.25.

This book is essentially a layman's edition of *Soil and Water Conservation Engineering* prepared by the same authors and published in 1955. The authors are agricultural engineers with an intense interest in adapting engineering techniques to the many phases of using soil, water, and plant resources wisely.

Even though the authors consider this a college textbook on soil and water engineering, it should be a useful manual for the practicing forester. The chapters on Field Notes, Measurement of Distances and Areas, Levels and Leveling, and Topographic Surveying and Mapping would be of little value to those who cruise, make boundary surveys or topographic maps as parts of their daily jobs. Those who do such jobs infrequently—even though they once knew

how—will find the notes on care and adjustments of surveying equipment good reminders. This alone might save the price of the book for those who use such equipment infrequently. The material on topographic surveying and mapping offers helpful hints that might save time and improve the quality of field notes.

Now that site preparation for hand and helicopter seeding is becoming standard operating procedure in some sections, the chapter on Land Clearing might help convince administrators that some of their equipment could be used "as is" or modified for tree planting site preparation.

Even though the chapter on Surface Drainage was written primarily for those who wish to learn how to get the water off cultivated lands faster, it may also help those who have a problem of growing trees on wet lands. Water level stabilization on forest lands is just another of the more intensive treatments that make growing wood crops much more profitable on certain kinds of soils.

Anyone who mastered the chapter on Rainfall and Runoff would not necessarily be accepted as a hydrologist by the hydrologists, but he could understand some of the things they talk about. For example, Cook's method of determining the runoff characteristics of a small watershed are discussed and illustrated by tables and examples. This could be helpful toward qualifying the reader as a watershed specialist by giving him a better understanding of forested watersheds.

For many foresters such subjects as striperopping, terracing, vegetated outlets, and farm ponds will not have much appeal. However, those who wish to work in the field of private forestry—especially with landowners and operators—will find these helpful.

Foresters will also find this book an easy way of extending their engineering knowledge to a very closely allied field—that of soil and water conservation.

T. B. PLAIR
Soil Conservation Service

Forestry Tenures and Taxes in Canada: The Economic Effects of Taxation and of the Regulating of the Crown Forests by the Provinces

By A. Milton Moore. 315 pp. Canadian Tax Foundation, Toronto. 1957. $3.

Described as the first comprehensive Canadian study in its field, this analysis provides detailed information on the forest tax and forest tenure situation in each of the 10 provinces. As used in the study, the term "tenures" relates to the prices charged for timber harvested from Crown lands and the conditions under which the Crown will permit its removal. Three forms of taxation are analyzed: the property tax, logging taxes (levied only in Ontario and British Columbia); and the Dominion income tax. The study is the first of a series on the natural resource industries planned by the Canadian Tax Foundation, an independent research organization sponsored jointly by the Canadian Bar Association and the Canadian Institute of Chartered Accountants.

The purposes of the study as stated in the Summary are twofold:

"First to discover whether investment in the forests is discouraged or encouraged in relation to other investment as a consequence of the weight of tax it bears. Second, to consider whether the Crown's regulation of its forests and the selling prices set for its timber are conductive to the most profitable use of the forests and are therefore in the public's best interests."

Findings of the study give neither the tax nor tenure situation an altogether clean bill of health and a number of suggestions for improvement are advanced.

The discussion of the Crown forests (comprising 70 percent of the total area of occupied forest land) will doubtless be of less immediate interest to the reader in the United States than that relating to taxation where the situation is more nearly parallel to that in this country.

For the most part Crown lands are under long-term lease to wood-using industries and are subject to payment of an annual ground rent in addition to stumpage charges at time of timber harvest. The study outlines several characteristics of present provincial administration that are thought to induce wasteful practices on Crown timber lands, and certain changes in landlord-tenant contractual relations are recommended with a view to enabling private enterprise to operate more efficiently on such lands.

The property tax discussion, with particular reference to Nova Scotia and British Columbia where detailed data are available, sounds a familiar note. In Nova Scotia it is reported that in the past, assessments have been haphazard, many properties remaining unlisted for years with no one but the owners knowing it. Assessments were occasionally appealed, but excessively burdensome forest taxation was not common. More recently, however, tax districts have been seeking every possible source of income. Re-assessment programs, initiated about 1950, will be completed before the end of the present decade. In some areas taxes are still reasonable but in many others were found to be so high as to preclude sustained yield management. In British Columbia as in Nova Scotia calculations show that property taxes, cumulated over a rotation, absorb a substantial portion of the value of the timber crop.

It is of interest that attempts to improve forest taxation have not centered about the yield tax but rather have sought to derive property tax assessments from the capitalized value of productive capacity. An application of this principle is found in British Columbia where provision is made for optional classification as "tree farms" of tracts under sustained yield management. The conversion to tree farm status of lands with fairly normal tree age distribution is reported to have reduced as-

sessed values by one-half to two-thirds. Assessments on the basis of capitalized productivity are also found in New Brunswick and possibly other provinces. As one solution of the property tax problem the study recommends a variant of the capitalized productivity approach. Under the proposed plan immature timber would be exempt from payment of property taxes and would be subject instead to an annual specific acreage tax. The amount of this tax would be calculated by site class in such a way as to take, when cumulated over a rotation, a predetermined proportion of the value of the estimated crop.

For the Ontario and British Columbia taxes on logging profits the study finds little rationale other than as anomalous departures from uniform business taxation. Comparable in a sense to timber severance taxes in the United States, these levies would seem to illustrate the well known principle that tax revenue will be sought where it can be found.

Although the Canadian income tax differs significantly from our own, forest owners encounter some of the same problems: the timing of deductions, calculation of the depletion allowance, and application of capital gains provisions. The United States reader must here tread warily, however, since seemingly familiar terms may prove deceptive. Following British practice, capital gains are excluded from taxable income but as with us, the line of demarcation between the two is not always clear. The study points out for example, that if a farmer logs his woodlot himself, the profit is regarded as ordinary income. If he sells both land and timber for a lump sum, the proceeds are usually regarded as a capital gain and hence are free of tax. When transactions fall between these two extremes, varying degrees of uncertainty may result. The tax advantages of *en bloc* (land and timber) sales are regarded as the chief indictment of the present income tax provisions.

Suggestions for income tax improvement include the current deduction of all planting costs (now permitted to the extent that the volume of planting bears a reasonable relation to the volume of timber cut during the taxable year) and replacement of cost depletion with a low rate of percentage depletion. The full implications of the latter proposal could perhaps have been more fully developed.

Appendices contain tables of forestry revenues and expenditures for each of the provinces and statistics of the lumber and pulp and paper industries. Readers in this country concerned with the subject fields will find much of interest in this thorough analysis of the Canadian situation.

ELLIS T. WILLIAMS
U. S. Forest Service

Effect of Environment on the Percentage of Summerwood and Specific Gravity of Slash Pine

By Philip R. Larson. 80 pp. Illus. Yale University School of Forestry, New Haven, Conn. 1957. $1.50.

If you want an example of what painstaking investigation can reveal, read this bulletin. It can be read from either of two viewpoints. The more obvious interest, of course, is to learn about the subject of the study—the effect of environment on certain properties of the wood of slash pine. From this point of view, the study unquestionably has advanced the knowledge of the subject. A second and perhaps equally compelling reason to read the report is to see what first class research techniques can do to explain relationships that were not clarified by earlier studies.

The study was undertaken because of the importance of wood quality factors that are associated with the specific gravity or density of wood of slash pine. In general, high and uniform density are desirable characteristics. The objective of the study was to evaluate by statistical methods (1) the influence of growth rate and age on summerwood percentage and specific gravity and (2) the influence of certain environmental factors on summerwood percentage in slash pine.

The study employed rather novel methods. Distinctive features included utilizing increment cores for the quality determinations, using exceptionally precise techniques in order to maintain accuracy with such tiny samples, and obtaining relatively large numbers of representative samples throughout the range of the type species (*Pinus elliottii* var. *elliottii*). From the standpoint of silviculturists, perhaps the most surprising features were the difficulty of obtaining accurate age determinations and the extreme care taken to establish ages accurately. Three kinds of difficult annual rings commonly occurred in the samples: microscopic rings, discontinuous rings, and false rings. Accurate age determination required extensive dendrochronological cross-checking. The efforts expended to measure ages with precision were fully justified by the findings.

A considerable number of conclusions were drawn from the study. Some of the more important are that specific gravity and percentage of summerwood are strongly correlated with age but not with rate of growth, and that much of the difference in percentage of summerwood can be accounted for by factors of environment. The best over-all expression for accounting for differences in summerwood percentage between plots was multiple variable June plus July rainfall in combination with depth of soil to a fine-textured horizon. This expression accounted for 55 percent of the total variation. Parenthetically, the reviewer notes here that if the rainfall estimates and the index period (June and July) could be further refined, perhaps these refinements would enable this variable to account for even more of the variation.

From the viewpoint of suggesting how a very creditable work could be made even better, the reviewer offers the opinion that the presentation is needlessly 'technical'' and involved. Simple concepts are obscured by the way they are said; the presentation is not organized for ready comprehension. A suspicion arises that the author, in condensing a Ph.D. thesis written for a committee of professors, has to some extent lost sight of the general reader. The bulletin would benefit from attention to simplified writing.

RUSSELL K. LEBARRON
California Forest and Range Experiment Station

Gifford Pinchot, The Man Who Saved the Forests

By Dale White. 192 pp. Julian Messner, Inc., New York. 1957. $2.95.

Gifford Pinchot was a figure who must have appealed to young people in his day; certainly teenagers today, the audience to which Dale White directs her book, will find the story of his pioneering and crusading in America an exciting one. It is the story of a man who, by the time he reached the age of forty, had transformed the government's Division of Forestry from little more than a mass of statistics into an efficient, workable force and had put to work the concept of forest conservation through use. He was friend and confidant of the President of the United States, Theodore Roosevelt.

Pinchot felt that the Division of Forestry should be a source of information to landowners throughout the country who wanted to employ conservation practices on their lands. He set up a consulting service and got so great a response that the staff required by the division grew rapidly. In 1905 the division became the U. S. Forest Service.

Since no forestry courses were being taught in this country in the 1880's, Pinchot had to get his training in Europe. In order to study forest conditions of his own country he traveled many miles back and forth across the continent. Pinchot's father, who was largely responsible for his son's interest in forestry, saw clearly the need for formal training in forestry in this country and so established at Yale the first American forestry school.

Like most every other American teenager, Gifford Pinchot was a football enthusiast. At Yale he played on the varsity squad. During his senior year he was beaten out for the quarterback position by a freshman, Henry S. Graves. The idea and language of football runs through the book as Pinchot attacks the problems of forestry and stresses teamwork among his staff of the Forest Service.

Western adventure also has its role to play in this life of Gifford Pinchot as he climbs mountains, gets involved in Indian attacks, fights for grazing control—even though it would probably seem tame compared to any Hollywood western.

JANE COOK
SAF Staff

Publications of Interest

Guide to Career Information, an annotated bibliography of recent career literature, is now available from Harper and Brothers Publishers at a cost of $3. Two of the book's 203 pages are devoted to material on forestry, with emphasis on ranger duties.

The book, compiled by the New York Life Insurance Company, lists pamphlets, full-length factual books, and novels dealing with almost any work imaginable, skilled and unskilled, for both men and women. Length, cost, and publisher's address are given for each item. A complete index makes the guide easy to use.

Copies have been distributed to selected libraries and vocational counselors in schools throughout the United States and Canada. Plans are underway to reprint sections in a series of separate pamphlets.

The Wonder of Water, a cartoon-type presentation in four colors, designed to tell the story of upstream watershed protection to more Americans, has just been released by the Soil Conservation Society of America.

The Wonder of Water is a story about a mythical community—Midvale—suffering first from drouth and later from flood. The water problems of the community were solved by the small watershed approach, with farm and city people, adults and students, participating.

The 16-page booklet is made available by sale to local business firms, industries, and other organizations and is designed to allow their use of the back page for a message. Information about its availability may be secured from the Soil Conservation Society of America, 838 Fifth Avenue, Des Moines, Iowa.

The Society has previously distributed a million copies of a similar booklet *The Story of Land.*

• • •

Timber, published by the Western Pine Association, tells the story of western pine region trees and forests. Planned to be specially useful to schools, the booklet explains and illustrates how to identify the ten leading commercial species of the region. Retailers, groups, and individuals can get up to 100 copies free by writing the publishers, Western Pine Association, Yeon Building, Portland 4, Ore.

• • •

The Ohio Agricultural Experiment Station, in cooperation with the Central States Forest Experiment Station, has studied wholesale markets for Christmas trees and has published its findings in *Marketing Ohio Grown Christmas Trees Through Wholesale Outlets.* G. H. Mitchell and R. R. Casey are co-authors. Material covvered includes preferred species for Christmas trees, purchasing procedures, and pricing. For copies of the booklet, Research Circular 47, 14 pp., write to the Ohio Agricultural Experiment Station, Wooster.

• • •

Planned Pulpwood Production is a new booklet released by Caterpillar Tractor Co. It deals with site preparation, as well as harvesting, planting, and equipment available. Also released is another booklet, *Northern Logging,* dealing with methods and equipment. Both booklets can be obtained from local Caterpillar dealers or by writing the company in Peoria, Ill.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State Uniiversity College of Forestry at Syracuse University*

Range Management Section Complied by Division of Bibliography, Library, U. S. Department of Agriculture

General

Cabin in the Woods. By J. R. Simmons. 181 pp. Meador Publ., Boston 15, Mass. $2.50.

Canada's Forests 1951-1955; Report to the 7th British Commonwealth Forestry Conference. 74 pp. Minister of Northern Affairs and Nat'l Res., Ottawa. 1956.

Timber: Its Development and Distribution. By Bryan Latham. 304 pp. Illus. James Thin, 53-59 S. Bridge St., Edinburgh, Scotland. 1957. 25/.

Forest Economics

An Appraisal of Methods for Salvaging Small-Sawmill Residues in the Southeast. By A. S. Todd and W. C. Anderson. 37 pp. Southeastern Forest Expt. Sta., Asheville, N. C. 1957. Sta. Paper No. 84.

The Demand and Price Situation for Forest Products. 37 pp. Illus. U. S. Forest Serv., Washington 25, D. C. 1957.

Marketing Timber from Iowa Farm Woodlands. 8 pp. Illus. Iowa State College Coop. Ext. Serv., Ames. 1957.

Forest Influences

A Guide to the Coweeta Hydrologic Laboratory. By R. E. Dils. 40 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N. C. 1957.

Snow and Frost Measurements in a Watershed-Management Research Program. By R. S. Sartz. 9 pp. Northeastern Forest Expt. Sta., Upper Darby, Pa. 1957. Sta. Paper No. 96.

Forest Products

A Record of the Timber Cut from Forests of the Lake States—1954. By A. G. Horn. 47 pp. Lake States Forest Expt. Sta., St. Paul, Minn. 1957. Sta. Paper No. 53.

Forest Resources

Forest Statistics for Lincoln County, Oregon. By J. H. Usher and H. H. Hall. 30 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1957. Forest Survey Rept. No. 129.

Logging and Milling

Heavy Losses in Air Seasoning Georgia Pine and How to Reduce Them. By R. H. Page nd R. M. Carter. 20 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N. C. 1957. Sta. Paper No. 85.

Pathology

Deterioration of Sugar Maple Following Logging Damage. By G. A. Hesterberg. 58 pp. Illus. Lake States Forest Expt. Sta., St. Paul, Minn. 1957. Sta. Paper No. 51.

The Dwarfmistletoes of California and Their Control. By J. W. M. Kimmey. 12 pp. Illus. California Forest and Range Expt. Sta., Berkeley. 1957. Tech. Paper No. 19.

Protection

Frequency of Dry East Winds Over Northwest Oregon and Southwest Washington. By O. P. Cramer. 19 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1957. Res. Paper No. 24.

Test of Wind Predictions for Peak Fire-Danger Stations in Oregon and Washington. By O. P. Cramer. 41 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1957. Res. Paper No. 22.

Silviculture

Effect of Environment on the Percentage of Summerwood and Specific Gravity of Slash Pine. By P. R. Larson. 78 pp. Illus. Yale School of Forestry, New Haven. 1957. Bul. No. 63. $1.50.

Silvical Characteristics of Incense-Cedar. By G. H. Schubert. 14 pp. California Forest and Range Expt. Sta., Berkeley. 1957. Tech. Paper No. 18.

Silvical Characteristics of Northern Red Oak. By I. L. Sander. 15 pp. Illus. Central States Forest Expt. Sta., Columbus, Ohio. 1957. Misc. Release No. 17.

Silvical Characteristics of Ohio Buckeye. By R. W. Merz. 12 pp. Illus. Central States Forest Expt. Sta., Columbus, Ohio. 1957. Misc. Release No. 16.

Silvical Characteristics of Red Alder. By N. P. Worthington. 15 pp. Illus. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1957. Silvical Ser. No. 1.

Silvical Characteristics of Scarlet Oak. By R. A. Campbell. 8 pp. Southeastern Forest Expt. Sta., Asheville, N. C. 1957. Sta. Paper No. 86.

Silvical Characteristics of Tamarack. By E. I. Roe. 22 pp. Illus. Lake States Forest Expt. Sta., St. Paul, Minn. 1957. Sta. Paper No. 52.

A Successful Direct Seeding of Sugar Pine. By W. I. Stein. 19 pp. Illus. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. Res. Paper No. 25.

Ten-Year History of an Oregon Coastal Plantation. By R. H. Ruth. 15 pp. Illus. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1957. Res. Paper No. 21.

Variations in Cone Properties, Seed Yield and Seed Weight in Western White Pine When Pollination is Controlled. By A. E. Squillance. 16 pp. Montana State Univ. School of Forestry, Missoula. 1957. Bul. No. 5.

Wood Technology and Utilization

Juvenile Wood in Conifers. By B. H. Paul. 6 pp. Illus. U. S. Forest Products Laboratory, Madison, Wis. 1957. Rept. No. 2094.

Malayan Timbers for Furniture. By P. K. Balan Menon and H. J. Burgess. Malayan Forest Serv., Kuala Lampur. 1957. Trade Leaflet No. 30. 50 cents. Reprint from Malayan Forester, July 1957.

Oregon Hardwood Plywood. By J. R. Pfeiffer. 32 pp. Illus. Oregon Forest Products Laboratory, Corvallis.

Plywood. 48 pp. Illus. Timber Development Ass'n., London, E. C. 4. 1957.

Production of Charcoal in a Masonry Block Kiln-Structure and Operation. 32 pp. Illus. U. S. Forest Products Laboratory, Madison, Wis. 1957. Rept. No. 2084.

Veneer Recovery from Douglas-Fir Logs. By E. H. Clarke and A. C. Knauss. 13 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. Res. Paper No. 23.

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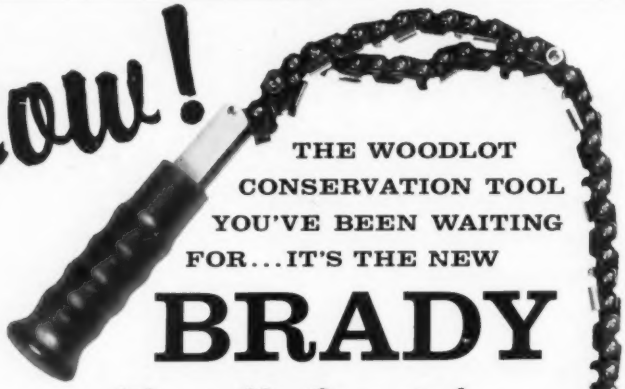

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Dendrology Publications of U. S. Forest Service

The U. S. Forest Service Check List recently has been reprinted and again is for sale after having been out of print the past two years. This and other dendrology publications at present for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., are listed below. Mention is made here, because U. S. Government publications are not advertised or widely listed or sold in book stores and usually are issued in limited editions and reprinted only according to the demand.

Check List of Native and Naturalized Trees of the United States (Including Alaska). By Elbert L. Little, Jr. U. S. Dept. Agric., Agriculture Handbook 41, 472 pp. 1953 (reprinted 1957). Price $2.25 (cloth).

Three other publications by the same author are for sale at the prices indicated:

Southwestern Trees; A Guide to the Native Species of New Mexico and Arizona. U. S. Dept. Agric., Agriculture Handbook 9, 109 pp., illus. 1950. Price 35 cents.

Important Forest Trees of the United States. U. S. Dept. Agric. Yearbook Separate 2156, pp. 763-814, illus. 1950. Price 20 cents.

Fifty Trees from Foreign Lands. U. S. Dept. Agric. Yearbook Separate 2157, pp. 815-830, illus. 1950. Price 10 cents.

The last two are also in this book, which still is for sale: *Trees, The Yearbook of Agriculture.* 1949. 944 pp., illus. Price $2 (cloth).

United States Tree Books; a Bibliography of Tree Identification. By William A. Dayton. U. S. Dept. Agric. Bibliographical Bulletin 20, 32 pp. 1952. Price 15 cents.

Forest Trees of the Pacific Slope. By George B. Sudworth. U. S. Forest Service, 441 pp., illus. 1908. Price $2.25. One of the first regional tree manuals, this comprehensive, well illustrated reference has been reprinted. However, Sudworth's other dendrology publications are not available.

Prices of most publications listed above are slightly higher than stated in the first printings, owing to higher printing costs. A discount of 25 percent is allowed to purchasers of 100 or more copies of a single publication to be mailed to one address and to all authorized bookdealers regardless of quantity.

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The Council's Column

On Reaching Maturity

Compared with other established professions forestry has been on the American scene for a very short time. In this brief period have we passed our infancy and adolescence into a mature and forceful group? What are the signs of maturity and what must we do to occupy a comparative position with other professions?

One prominent sign of maturity widely manifest among foresters is the deep-seated conviction that forestry is based on well-ordered facts and scientific principles—not rules-of-thumb or trial-and-error methods. On the whole, foresters are not only asking questions but demanding answers based on fundamentals. Where fundamentals are lacking their next approach is to urge a program of research which will give the answers. Join in conversation with any group of foresters today and before long the need for more and better answers to basic questions will be expressed.

An evident sign of maturity has been brought about by the accelerated trend toward intensive management. Obviously, we have a long way to go in this direction and there is an exciting future ahead.

Unity of thought and action among foresters is another true sign of maturity within the profession. We may have rivalry between men trained in different specialties, between territorial groups, or between public and private employees. Generally, these rivalries are stimulating and wholesome. In the final analysis, at the professional level rivalries disappear in objective considerations which unify us. Doubts

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on this point can be quickly dispelled by attendance at any Society of American Foresters meeting throughout the nation.

Strong evidence of maturity is apparent in the acceptance of foresters by members of other professions. This acceptance is expressed in community and civic life where foresters enjoy stature equal to that of doctors or lawyers. Incidentally, this has been achieved in the face of the basic fact that a forester's income is not usually equivalent to that of other professionals. This is a relationship that we must work aggressively to correct by getting recognition of the forester's real and significant contribution.

Maturity is also manifest in the traditions and policies that characterize our profession. Any group or organization must live with time to develop traditions. We have done this. Appraise the traditions accepted by you and your associates, your company, department, or bureau. You will find they are influencing your day-to-day operations more than you may realize. Similarly policies influencing the practice of forestry are constantly being clarified and more widely accepted. In some instances these policies now may be more generalized than in our adolescence, a definite sign that with maturity comes realization that broad applications require general policies which can be adapted to specific local situations as needed.

One very specific indication of maturity is the growth of the profession in the consulting field. Consulting forestry has passed the pioneering stage and the men in it are doing a major service in attaining public acceptance of professional stature.

These are the signs of maturity. Others could be listed but these are enough to characterize our position today. They furnish a positive answer that the profession has reached maturity.

What must we now do to wear this cloak of maturity with dignity? Actually no drastic changes are needed, but we cannot stand still. We need more accomplishment in the directions of current achievements with such adjustments as time requires. We need more constructive unity of thought and action within the profession. This does not mean uniformity of decision or opinion because honest differences result in progress. Instead it means we need unity in a desire to seek basic answers to our problems, to see that such answers are obtained, to search for an objective and constructive approach with full recognition of all circumstances and points of view.

Maturity and dignity require proud recognition within our own group that the forestry profession is a vital one and has a distinctive service to perform. Further, that each forester must take the time to keep currently informed on technological developments in spite of administrative pressures or commitments. Socially, and politically, we must take our true place in day-to-day developments. We cannot exist in a forestry vacuum where trees blot out the needs of people.

Finally, achievement of maturity carries obligations. Wise of age, loaded with energy and enthusiasm, and with public acceptance of our professional maturity, we can chart a course toward full assumption of our responsibilities.

CHAS. A. CONNAUGHTON

Editorial Board Changes Announced

President George A. Garratt has appointed four new members to the editorial board of the JOURNAL OF FORESTRY. The appointments were made necessary by the resignations of Associate Editors Ralph W. Marquis, Robert R. Blumenstein, Clarence W. Richen, and S. R. Gevorkiantz, who asked to be relieved of their duties on the basis of length of service and pressure of other work.

Lee M. James, the new associate editor for *Forest Economics and Policy*, replaces Dr. Marquis, associate editor in that field since January 1953. Dr. James is associate profes-

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sor of forestry at Michigan State University, East Lansing. He received his M.F. and Ph.D. degrees from the University of Michigan in 1943 and 1945 respectively, after getting his B.S. degree from Penn State in 1937.

Mr. Blumenstein was appointed associate editor for *Forest and Wood Utilization* in April 1954. His duties will be assumed by James S. Bethel, associate professor of wood technology at North Carolina State College, Raleigh. Dr. Bethel, a native of New Westminster, British Columbia, received his B.S.F. degree from the University of Washington in 1937, his M.F. and D.F. degrees from Duke in 1939 and 1947.

George H. Schroeder, chief forester for Crown Zellerbach Corporation, Portland, Ore., replaces Mr. Richen as associate editor for *Forest Management and Engineering*. Mr. Richen has filled the position since April 1953. Mr. Schroeder is a graduate of Oregon State College, having received his B.S. degree in 1935 and his M.S. degree in 1936.

C. Allen Bickford, Northeastern Forest Experiment Station, Upper Darby, Pa., has been selected to fill the post vacated by Dr. Gevorkiantz, associate editor for *Mensuration*. Dr. Gevorkiantz was appointed to the editorial board in October 1946. Mr. Bickford has been with the U. S. Forest Service since 1931. He received his B.S. degree from Dartmouth in 1925 and his M.S. from the University of Idaho in 1931.

The JOURNAL, on behalf of President Garratt, the membership of the Society, and especially of the editorial staff, expresses sincere thanks to the outgoing associate editors for their contributions to professional literature.

Distribution of Age Groups in Forestry Indicated by Sampling

Foresters are accustomed to thinking of age-class distribution for purposes of forest management. They may not so often consider age-class distribution among people, although the increase in older age groups is frequently mentioned in the press.

What is the age class distribution among foresters? Such statistics might be difficult to compile for all foresters in the United States, but a sampling of Society members should prove reasonably indicative. Upon request of the Council an analysis was made of Society records to arrive at an answer.

On the basis of an 11 percent sample the distribution is as follows:

Years	Percent
71 and over	3
61 - 70	5
51 - 60	14
41 - 50	25
31 - 40	33
30 and under	20
	100

These figures do not apparently disclose any unusual irregularity between groups. There is a dropping off in numbers under 30 years of age, but this can be easily explained by the fact that few young men finish school and have an opportunity of joining the Society before they are 24 or 25 years old. Thus this group, to be comparable to the others, would need to be about doubled in the statistics.

It may be of interest to some agencies or companies to compare their age class distribution with that given above.

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Helmut A. R. Bach (1934-1957)

Helmut A. R. Bach, 23, was struck by an automobile and killed recently at Fort Leonard Wood, Mo. He was serving as a private in the Army.

Bach, whose residence was Dearborn, Mich., was born in Zeulenroda, Germany, March 30, 1934. He applied for his first citizenship papers in 1951. After attending Henry Ford Community College for two years, he transferred to the University of Michigan and received his B.S.F. degree from there in June 1956.

William H. Moore (1901-1957)

William H. Moore died on December 5 after a long illness. He was vice president of The Southern Resin & Chemical Company, Glen Saint Mary, Fla., a subsidiary of Rohm & Haas Company, Philadelphia. Born in Parkesburg, Pennsylvania, December 8, 1901, Mr. Moore graduated in forestry from Pennsylvania State University in 1923. While a partner in Forest Managers, Inc., a consulting firm, he participated in the location and management of the first tract acquired by Southern Resin & Chemical Company in 1932. After a period of employment as chief of forest engineering for the Union Bag & Paper Company, he resumed his connection with Southern Resin and in 1946 he was employed as general manager of the company with headquarters at Glen Saint Mary.

In 1952 he was elected a vice president of the company. A year ago, poor health forced him to curtail his field activity, although he remained at company headquarters as advisor to W. B. Nagle, who succeeded him as general manager early in 1957.

The 1957 Fellow Election: A Brief Analysis

The results of the 1957 biennial election of Fellows were reported in the January issue, page 3.

Prior to this election, a special committee of the Council (J. S. Illick, Chairman) had made a study of the election procedures for Fellows. The report of this committee, published in the June 1956, issue of the JOURNAL (pp. 410-414), contained several recommendations subsequently approved by the membership in a referendum held August 31, 1957.

The most important amendment to the Constitution as a result of this referendum (see the JOURNAL for November 1957, p. 863) was an increase in the number of electors to include, in addition to all Fellows and members of the Council, the chairmen of the 21 Sections and the chairmen of the 11 subject Divisions.

Thus for the election of December 2, 1957, there were 114 electors, as follows: 75 Fellows; 8 members of the Council who were not Fellows; 21 chairmen of Sections; and 10 chairmen of subject Divisions. One chairman of a Section was also chairman of a Division.

Actually, 91 valid ballots were cast. Of the 30 members who had been nominated for the grade of Fellow, 16 were elected. This was the largest number of Fellows ever elected in any one election. Previously, the largest number elected in any one election was 11.

To make a critical analysis of these election results, one would have to know how each individual elector voted. Since this is impossible in a secret ballot, the following generalizations are pertinent:

1. Obviously the broadening of the voting base to include Section and Division chairmen (younger men) has loosened up the election as more Fellows were elected this year than in any previous one. The younger voters were either less critical or more generous.

2. Nominees from forestry schools fared better than others. Three out of four professors were elected whereas the record for other categories was: industry 3 out of 7, U. S. Forest Service 4 out of 8, state forestry 4 out of 7, and miscellaneous 2 out of 4.

3. Age apparently did not have any great effect except in the very oldest and very youngest groups. Five out of ten in the 1890-1900 bracket were elected and 9 out of 15 in the 1900-1910 bracket. The two youngest candidates (1910-1920) did not make it whereas 2 out of 3 of those born before 1890 were elected.

4. Wide experience in more than one region seems to have made some difference. Six out of eight with wide experience in more than one region were elected whereas only 10 out of 22 of those whose experience has been mostly in one place were so awarded. Several men, however, were elected whose experience has been almost entirely at one geographical location.

Recognition received through the writing of a forestry book (not bulletins) apparently had some effect. At any rate, the two men in this group were both elected.

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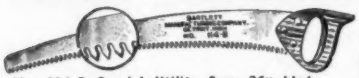

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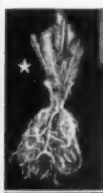

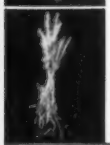

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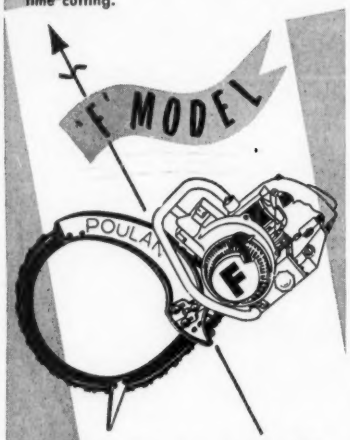

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Intermountain Section Meets

The fall meeting of the Intermountain Section of the Society of American Foresters was held December 7 at Pocatello, Idaho. The meeting was called to order by Section Chairman George V. Hjort. There were 50 members present.

The following papers were given: "The Use of Sodium Borate in Forest Fire Control," by George Lafferty, fire control officer, Boise National Forest; "Douglas-Fir Bark Beetle—Some Aspects," by Malcom Furniss, entomologist, Boise Research Center; "Glue Laminations and Chipboard," by Dave Lowery, Intermountain Forest and Range Experiment Station; and a panel discussion on "Recreational Developments."

The business meeting included a report on plans for the national meeting, which is to be held in Salt Lake City in 1958.

The banquet dinner was served in Hotel Bannock, following a social hour. Guest speaker was Dr. Edson Fichter of the Zoology Department of Idaho State College, who spoke on "Predation." An entertaining skit was enacted by the forestry students of Idaho State College.

Coming Events

Allegheny Section

The winter meeting of the Allegheny Section will be held February 13-15 at the Penn-Sheraton Hotel, Pittsburgh, Pa.

Appalachian Section

The annual winter meeting of the Appalachian Section is scheduled for February 14-15, 1958 in the Sir Walter Hotel, Raleigh, N. C.

Central Rocky Mountain Section

In conjunction with Forestry Days at Colorado State University the Central Rocky Mountain Section will meet February 21-22 at Fort Collins, Colo.

Wisconsin-Upper Michigan Section

The winter meeting will be held March 14-15 in Milwaukee, Wis. (place not yet announced). Theme: "Using Public Relations to Promote Forestry." Total emphasis will be on forestry, not forestry *organizations.*

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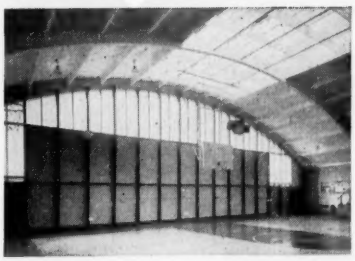

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The Society of American Foresters and I

(Editor's note.—Prof. Archie E. Patterson of the School of Forestry, University of Georgia, was invited last October by the Florida Chapter of the Southeastern Section to discuss what the Society means to him. The following remarks are of such wide application that they are published here for the interest of members and prospective members.)

When first approached with the idea of becoming a member of the Society, the average forester replies: "What do I get out of it?" Perhaps, after several years as a member you are asking yourself the same question. Since the title of this Symposium has placed this discussion on a personal basis, I shall approach it from a strictly personal basis, and attempt to explain to you some of the benefits I get out of the Society, and what they mean to me personally.

Let me dispose of the more mundane aspects first. I get the JOURNAL OF FORESTRY. True, I could purchase it as a subscription for much less than my annual dues; but, I do receive it. In itself, I consider it a publication well worth the price. Each month it brings to my desk the best of forestry literature in the United States. Of course, I do not always read each article and I do not always agree with those I do read; but, because I am a member of the Society I have recourse not open to non-members. If I do not agree, and if I feel strongly enough about the point, I may, and I have, used the pages of the JOURNAL as a forum for debate and rebuttal.

Psychologists tell us that fundamentally each of us wishes to be heard, and to be recognized. I know of no better way to be heard among foresters than to place your name on an article or opinion, and send it to the JOURNAL OF FORESTRY. Frankly, I could stop right here and truthfully say that from this aspect alone, I get my "money's-worth" out of the Society.

But the Society means more than this to me. I belong to no other organization that sponsors several meetings a year which allow me to listen to professional forestry articles and professional opinions, and in addition makes it possible for me to meet with old friends, and renew acquaintances from other states and other regions. In other words, the Society will not allow me to become provincial in my thinking, and I thank God that that is true!

Is this all the Society does for me? Far from it! The Society gives me a host of intangibles. It sets before me far-reaching intangible goals. Many of these goals are set forth in the Society's Code of Ethics. Unfortunately, however, there are many members of the Society who do not understand, and therefore do not appreciate, what the Code of Ethics means to the public, to the profession, and to themselves as individuals. Perhaps by means of this discussion I can give you an idea as to what it means to me.

The development of a Code of Ethics by a Society is an indication of its adjustment to surrounding conditions. Acceptance of the Code by an individual is an indication that he has realized that he owes more to others than he does to himself, and that he cannot "live by bread alone." In either case, whether we be speaking of a Society or an individual, development and acceptance is an indication of maturity.

In many ways the forester is similar to other professional workers. In a few ways, especially in relation to his work, he is decidedly different. Most

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foresters, even at an early stage in their career, work alone under a heavy load of responsibility. Their every action may potentially involve large sums of money, or the safety and welfare of present or future populations. Instant decisions are often necessary, both in times of stress and in everyday work. In such moments the forester must rely upon his technical training, his former experience, and his moral judgment. The last of these is seldom the least important. Foresters are not exempt from human weaknesses or temptation, and unless they are guided by a code of ethics they may unwittingly make the wrong decision.

Furthermore, no individual member of a profession can live in a world alone. Just as his training and professional knowledge are based on the experience, research, and thinking of those who have preceded him in the profession, his present and future gains must come through a continuous exchange of information with his colleagues. Although he may make some progress without this exchange, it will be slow and halting. Those who have passed their knowledge on to him in the past have given to him not only a means of service and livelihood, but also a staggering responsibility. This knowledge must be put to its best use, and he must consider it his private responsibility that it is used fairly, and only for the purpose for which it was intended.

Thus, in accepting a code of ethics the individual agrees to discipline himself according to the dictates of the code; and in return he is favored with protection from the egoistic and selfish motives of fellow workers. In addition, he receives the confidence of the public, who may not know him personally, but who know the moral obligations of the profession. This public confidence can only be maintained by the individual by a show of both technical and moral competence in all instances. The code should always be foremost in the mind of the forester, and his every thought and action should be tested in its crucible.

The Code of Ethics, however, was not designed merely to protect the professional forester, or to promote the interest of the profession itself. The foremost objective of the Code of Ethics is to further the interests of the public which the profession serves. It is based, therefore, largely on altruism and a sense of service, rather than egoism.

This attitude certainly does the profession no harm. When advertised, in a dignified manner before the public, it attracts respect for the profession and its individual members. When the public realizes that the members of the profession are required not by legislative law, but by their own group action to protect the public interest, a faith in the ability of the individual and in the work which he performs is generated.

By honoring professional codes of ethics, whether they be concerned with forestry or some other profession, the public is essentially admitting that it is incapable of protecting itself from unscrupulous members of the profession, and looks to the profession itself for protection. This is as it should be. Seldom is the layman able to judge whether or not the professional worker has performed his services in the best interests of his client, or to the best interests of the public as a whole. Thus, the greater the skill required in the practice of the profession, the greater the need for a rigidly enforced

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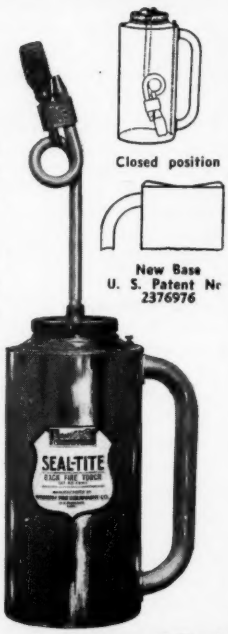

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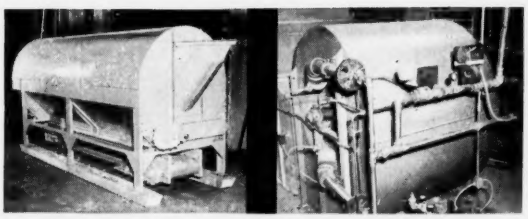

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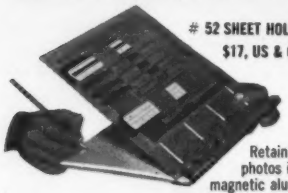

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code of ethics.

With the advent and rapid development of the practice of intensive forestry in America, the profession of forestry has moved into the category of the highly skilled professions. With this new authority has come the balancing factor: a new responsibility toward the public.

I have heard some members of the profession of forestry contend that a written code of ethics is unnecessary; that an unwritten code, based on an intensive "esprit de corps" and the supposition that all members of the profession are gentlemen and will conduct themselves both in business and pleasure as such, is enough. In a numerically small, compact profession this line of reasoning is good and frequently workable. In a profession with thousands of members of varied employment and many interests, it is mere wishful thinking.

Since the reputation of any group is based upon the conduct of its individual members, the enforcement of the code becomes a matter of self preservation to the group. Without this cooperation among individuals and groups, our modern society could not exist. The absence of such cooperation leads to anarchy and chaos. Throughout the ages man has learned to cooperate with his fellowman, and has gradually evolved, and allowed himself to be subject to, various forms of government which have encouraged or forced various degrees of cooperation. At the pinnacle of this mass of trial and error governments stands the democratic form, the highest level of cooperative organization ever devised. The secret of success of the democratic process lies in the acceptance by the majority of necessary rules, with the emphasis in such rules being placed upon the "thou shalt not" type, and leaving the individual unlimited freedom in unrestricted areas. Destroy this fundamental principle and democracy will no longer exist.

So it is with our Code of Ethics. It forms the crystallized sentiment of the majority, and can always be used as a basis of moral suasion among recalcitrant individuals. It also serves to educate the younger members in the honor of the profession, and is looked upon with pride by the older members.

I believe I could stand here before you for hours and recite to you intangible benefit after intangible benefit that I can trace directly or indirectly to the Society. I need not do so, because a frank perusal of your own mind and experience will bring forth many of the same. I would, however, beg your indulgence while I list another.

Of all that I have received from the Society, I am most proud of the professional standing which the Society has given me. No longer am I considered a woodchopper, a tree planter, or a fire tower sitter. And I do not cast aspersions on these or other noble arts of manual labor, when I say that the Society through 57 years of concentrated effort is largely responsible for lifting the forestry profession from the realm of manual efforts to the plane of administrative and technical responsibility. True, it has been a slow and disheartening process, and in some areas the battle is not yet entirely won. But, the beginnings have been made, and in at least two states, and shortly in many more, forestry has been given professional status by sovereign law. No longer must I, as a forester, take a balcony seat in the hall of recognized professions. Today I am a member of a body of professional foresters 11,000 strong, a part of a great movement for the good of our nation, a member of a Society that has my reputation and my welfare at heart.

When I look back over the years that I have been a member of the Society, and which now approach one-half of the Society's total life, I feel a constant and growing indebtedness. Irregardless of what I have brought, or may ever bring, to the Society, I feel I shall never be able to repay the debt of being allowed to be a member of the Society.

And if I may, I would like to speak for a moment to the younger members of our profession who are with us today. It would not be impertinent of you younger men to ask: Have not all the goals been won?

I tell you, gentlemen, the fact that the Society of American Foresters has stood the test of over half a century is not an absolute guarantee of its continuance indefinitely. Mere age, it must be remembered, is no final criteria of usefulness and merit. I challenge you to active work and leadership in the Society, and I promise you will be rewarded with recognition in your profession, in your job, and among your colleagues.

Yes, the Society means many things to me; some tangible, some intangible; but all good, important, and valuable. And I know that for what it has given me, and for what it has meant to me, I am a better man and a better forester because of it.

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Report of the Committee for the Advancement of Forestry Education

The report of the Committee for the Advancement of Forestry Education naturally falls into two parts: The renewed accreditation of the School of Forestry at Montana State University, and a new set of standards for accrediting schools of forestry.

Montana State University

The School of Forestry at Montana State University has been fully accredited by the Society of American Foresters since June 1953. This year, however, the Northwest Regional Association of Colleges and Universities instituted a review of Montana State University as a whole; and it was considered desirable for the Society of American Foresters to participate by reviewing the School of Forestry.

The School of Forestry prepared the usual questionnaires, which were reviewed by the Committee for the Advancement of Forestry Education. In addition, Mr. Clepper and Dean Wohletz of the University of Idaho served as a Visiting Committee, inspecting the School of Forestry on the ground. Their report, and the "Self Evaluation Report" of the School of Forestry were reviewed by our Committee before the annual meeting.

As a result of our review and the Visiting Committee's recommendations, the Committee for the Advancement of Forestry Education unanimously recommended to the Council of the Society that accreditation of the School of Forestry at Montana State University be continued. This recommendation was unanimously approved by the Council at its meeting Sunday, November 10, 1957.

Revised Standards for Accrediting Schools of Forestry

For over a year, the Committee for the Advancement of Forestry Education has worked on the review and revision of the "Bases for Accrediting Schools of Forestry." The objectives were, first, to establish a set of general guiding principles which would serve as a definitive basis for accreditation and would be supported by a set of quantitative standards; and, second, to streamline and bring up to date the quantitative standards themselves. This process involved a change of emphasis as compared to the previous procedure. Where, up to now, primary weight has been placed upon the quantitative standards and the numerical rating derived from them, the new plan would place primary weight on the general principles. These are stated below:

General Principles

In order to be considered for accreditation, a Department, School, Division, or College of Forestry must meet the following general requirements in addition to the specific criteria described in the following grading system. These general principles are as follows:

(a) Accreditation by a regional accrediting association, of the whole educational institution within which the School, Department, Division, or College functions;

(b) Adequate instruction in biological sciences, physical sciences, social sciences, humanities, and engineering to provide the necessary basis for professional training in forestry;

(c) A faculty of at least five men in the Department, School, Division, or College of Forestry, trained in forestry and teaching an adequate curriculum in professional forestry which must include the areas of silviculture, protection, management, economics, and utilization; plus the equivalent of at least one additional man teaching courses within this curriculum and designed specifically for foresters;

(d) The Forestry College, Department, Division, or School must have offered a program of instruction leading to a bachelor's or master's degree in the professional field for at least five years before being considered for accreditation.

The above principles will form the main basis for accreditation, and will be given dominant weight by the Committee for the Advancement of Forestry Education as they consider any forestry school.

In addition, the following accrediting procedures will provide a numercial score for each of eight main categories. This grading system is intended as a guide to the Committee and, in part, as a quantitative basis for accreditation. The numerical scores are only used as a set of indices, to indicate those elements of an institution which are unusually weak or strong.

The final recommendation of the Committee for the Advancement of Forestry Education to the Council of the Society of American Foresters is based upon a qualitative analysis of all pertinent factors, including the judgment of a Visiting Committee based on a careful on-the-ground review of the institution in question.

To indicate the nature of the quantitative standards, the following

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tabulation shows their eight major subdivisions and the percentage weight assigned to each:

Summary of Bases and Weights

Base	*Weight*
I. Institutional status of forestry	8
II. Faculty—size and duties	18
III. Faculty—qualifications	20
IV. Supporting departments	12
V. Financial support for forestry	14
VI. Equipment	10
VII. Field instruction	13
VIII. History of school	5
	100

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After a preliminary meeting in 1956 in Memphis, a good deal of correspondence during the year, and a full day's meeting in Syracuse on November 8, our Committee completed the preparation of the new Standards in final form. These were submitted to the Council of the Society and unanimously approved at the Council's meeting on November 10.

Related Council Actions

In addition to approving the new Standards, the Council took two related actions, designed to facilitate the work of the Committee and the use of the new Standards:

1. In future, the Visiting Committee to any school of forestry will consist of two men representing the Committee for the Advancement of Forestry Education, plus the executive secretary of the Society.

2. One feature of the accreditation standards is a scale of salaries for forestry educators. By instruction of the Council, the executive secretary of the Society will review this table every two years starting in 1958, altering salary levels as needed to meet current living conditions.

H. G. WILM, *Chairman*

All other reports delivered at the Society Affairs session SAF annual meeting, Nov. 11, 1957, were published in the January JOURNAL.

Report of The Committee On Safety

You will recall that the Council charged the Committee on Safety with these points when it was set up in 1952:

1. Acquaint foresters with the safe practices applicable to occupations related to their fields.

2. Acquaint them with the procedures for getting safe practices into use.

3. Actively participate in safety programs.

4. Assist forest schools to indoctrinate students in the principles of safety.

So far your Committee has concentrated on the last two points—participating in safety programs, and indoctrination of forestry students. Our latest project, just mailed to Forest School Deans, is an *Outline of Suggestions for Integrating Safety into Forest School Curricula.* This is, of course, for optional use.

As the safety program of the forestry profession unfolds, it becomes more and more apparent that safety is a constructive element rather than a regulatory one. Proper job methods invariably result in not only better safety experience, but also better production experience. Therefore, in the background of any curriculum should be a definite conviction based on the truth that efficient production and safety go hand in hand. The prejudice of a management or an industry that is tackling a new idea nearly always is a negative one. Training of students in safety will go a long way toward minimizing this prejudice. We are happy to report that some schools have exceeded these suggestions.

Next year we hope to start work on a Safety Code for Foresters. This will cover the first two points on the Committee on Safety charter—acquainting foresters with the safe practices and procedures related to their work. We will also, of course, continue to participate in safety programs. The Committee welcomes any ideas any of you have to further implement its charter from the Council.

SETH JACKSON, *Chairman*

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatements received in the Society office during the month of December are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of March 1958. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Abbey, C. W.
Anderson, R. S.
Brenneman, B. B.
Clarke, J. F.
Devlin, R. J.
Hornbeck, J. W.
Kurtz, S. M.
Lewis, E.
Moore, T. R.
Peace, R. T.
Rotell, A. J.
Schmid, G. M.

Junior Grade

Deitz, J. E., County Forester, Cons. Comm., Huntington, W. Va. (Reinstatement).

Student Eligible for Automatic Advancement

PENNSYLVANIA STATE UNIVERSITY

Duhnkrack, A. R.

Appalachian Section

Student Grade

DUKE UNIVERSITY

Wyrick, J. L.

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NORTH CAROLINA STATE COLLEGE

Price, T. L.

Junior Grade

Clayton, J. F., Co. Forester, N. C. Forest Service, West Jefferson, N. C.; N. C. State, B.S.F., 1950.

Member Grade

Winkworth, R. C., Raleigh, N. C. (Reinstatement).

Central Rocky Mountain Section

Student Grade

COLORADO STATE UNIVERSITY

Hoefer, D. R. W.

Central States Section

Student Grade

PURDUE UNIVERSITY

Sutto, A. R.

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Johnson, R. S. McAndrews, K. M.

White, D. R.

Junior Grade

Beal, C. G., Forester, USFS, Hebo, Ore.; Univ. of Maine, B.S.F., 1954.

Larson, M. L., Logging Supt., Robert Dollar Co., Alendale, Ore.; Ore. State, B.S.F., 1948.

Storm, D. E., Land Classification Dir., Ore. Board of Forestry, Salem, Ore. (Reinstatement).

Swearingen, L. V., Logging Eng., Robert Dollar Co., Glendale, Ore.; Univ. of Wash., B.S.F., 1950.

Webster, G. R., Forester, Al Peirce Co., Coos Bay, Ore.; State Univ. of N. Y., B.S.F., 1950.

Student Eligible for Automatic Advancement

OREGON STATE COLLEGE

Hill, C. V.

Member Grade

Dugan, C. M., Forester, Georgia Pacific Corp., Coquille, Ore.; Mont. State, B.S.F., 1950. (Junior 1953).

Lynd, H. C., Asst. Dist. Forester, B.L.M., Rosenburg, Ore.; Ore. State, B.S.F., 1951. (Junior 1951).

Moore, F. W., Dist. Mgr., Simpson Logging Co., Idanha, Ore.; Ore. State, B.S.F., 1951. (Junior 1951).

Affiliate Grade

Abrams, G. D., Forester, Mt. Jefferson Lbr. Co., Lyons, Ore.

Swenson, E. B., Chief Forester, Menasha Wooden Ware Corp.

Gulf States Section

Junior Grade

Student Eligible for Automatic Advancement

LOUISIANA STATE UNIVERSITY

Moore, J. E.

Affiliate Grade

Green, H. E., Forester, USFS, Gloster, Miss.

Houser, W. E., Supt. Tbr. and Lands, Anderson-Tully Co., Memphis, Tenn.

Jackson, R. S., Asst. Dist. Ranger, USFS, San Augustine, Texas.

Pace, G. L., Forester, USFS, Gloster, Miss.

Parker, E. S., Area Forester, Miss. Forestry Comm., Lucedale, Miss.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Foltz, W. G. Leach, T. E.

Intermountain Section

Student Grade

UTAH STATE UNIVERSITY

Hanson, M. L. O'Neill, P. G.

Nebeker, D. T. Peterson, G. E.

Junior Grade

Carlson, H., Forester, Soil Cons. Service, Garden Valley, Idaho; Iowa State, B.S. (Forest Mgmt.), 1936.

Emory, D. M., Forester, Boise Cascade Corp., New Meadows, Idaho; Univ. of Idaho, B.S.F., 1957.

Long, M. G., Forester, USFS, Jackson, Wyo. (Reinstatement).

Quigley, L. G., Forester, USFS, Kamas, Utah; Utah State, B.S.F., 1939.

Affiliate Grade

Peterson, L. A., Forester, USFS, Richfield, Utah.

Kentucky-Tennessee Section

Affiliate Grade

Bruna, J. F., Dist. Wildlife Biologist, Elizabethtown, Ky.

Deimler, T. R., Cpl. U. S. Army. (Scoutmaster), Fort Knox, Ky.

New England Section

Student Grade

UNIVERSITY OF MAINE

Bowen, A. T. Hogan, E. P.

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Wood, D. C.

YALE UNIVERSITY

DeBrunner, L. E. Haalck, H. G. J.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Brewster, R. T. McKeon, J. J.
Dutcher, J. E. Neu, R. L.
Fedde, G. F. Rasmussen, E. P.
Fialko, L. D. Reed, R. E.
Graf, L. G. Woodmansee, D. W.

Junior Grade

Student Eligible for Automatic Advancement

STATE UNIVERSITY OF NEW YORK

Thomas, D. R.

Northern California Section

Student Grade

UNIVERSITY OF CALIFORNIA

Butler, W. E. Korthals, K. W.
Housden, E. N. Oliver, A.
Parady, R. A.

Junior Grade

Ford, A. W., Forester, Collins Pine Co., Chester, Calif.; Univ. of Calif., B.S.F., 1941.

Affiliate

Vite, J. P., Project Leader, Bryce Institute of Tech., Nevada Co., Calif.
Waggoner, R. F., Ranger, Calif. Dept. of Natural Resources, Arnold, Calif.

Northern Rocky Mountain Section

Junior Grade

Symes, R. G., Service Forester, Mont. Forestry Dept., Mont. State, B.S.F., 1957

Student Eligible for Automatic Advancement

MONTANA STATE UNIVERSITY

Eberle, D. R.

Member Grade

Howarth, N. J., Ranger, USFS, Ennis, Mont.; Mont. State, B.S.F., 1950. (Junior 1953)

Affiliate Grade

Farbo, T. P., Asst. Ranger, USFS, Troy, Mont.

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Mokry, T. J.

Affiliate Grade

Sirmon, G. A., Asst. Dist. Ranger, Dierks Forests Inc., DeQueen, Ark.
Sirmon, G. E., Block Forester, Fordyce Lbr. Co., Fordyce, Ark.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Dowdell, D. G. Selle, P. F.
Good, D. H. Thompson, J. L.
Hastey, E. L. Van Cleve, K.

Junior Grade

Ayers, J. H., Dist. Ranger, USFS, Winthrop, Wash. (Reinstatement).

Associate Grade

Norris, A. L., Vice-Pres., Chem-Air Inc., Seattle, Wash.

Southeastern Section

Student Grade

ALABAMA POLYTECHNIC INSTITUTE

Arnold, B. G. Harmon, P. F.
Brogden, R. E. Howell, J. E.
Burns, S. E. J. Leonard, R. E.
Davis, D. M. Lowe, J. R.
Davis, J. C. McMillan, A. M.
Doughtie, N. C. Paul, T. W.
Guinn, L. S. Pepper, W. D.
Griffis, L. G. Spears, J. D.
Hamilton, R. N. Stanford, M. H.
Hammond, C. N. Watson, W. J.
Haney, H. L. Williams, R. M.

UNIVERSITY OF FLORIDA

Miskimen, G. F. Whitman, J. D.

UNIVERSITY OF GEORGIA

Cook, T. P. Devereaux, T. L.

Junior Grade

Thaxton, J. W., Capt., USAF, Homestead AFB, Fla.; Univ. of Calif., B.S.F., 1949.
Wiant, H. V., Grad. St., Univ. of Ga.; W. Va. Univ., B.S.F., 1954. (Reinstatement).

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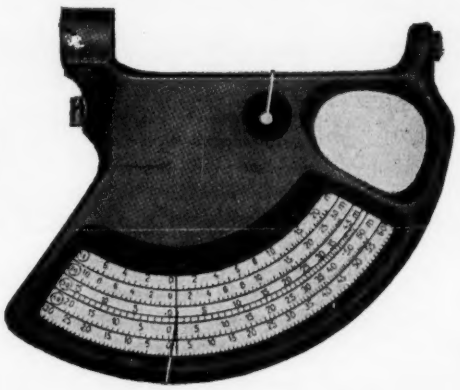

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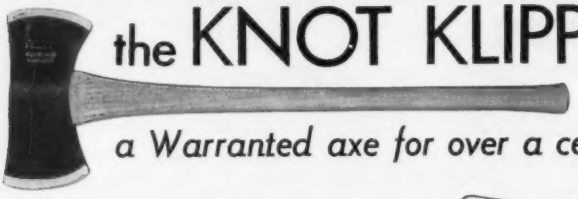

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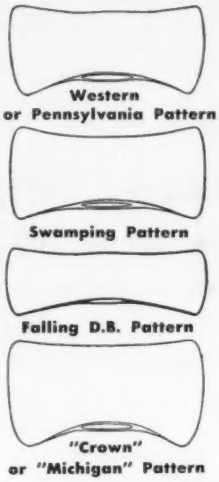

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Member Grade

Cook, D. R., Industrial Forester, Gulf States Paper Corp., Tuscaloosa, Ala.; API, B.S.F., 1950. (Junior 1951).

Affiliate Grade

Davis, M. V., Land Div. Supt., American Agric. Chem. Co., Pierce, Fla.

Upper-Mississippi Valley Section

Student Grade

IOWA STATE COLLEGE

Dahlquist, R. B. — Keller, D. V.
Rardin, D. L.

UNIVERSITY OF MINNESOTA

Carlson, H. N. — Hinds, L. R. W.
Cowan, P. C. — Mattson, R. B.
Engelsen, D. M. — Murphy, G. E.
Fenstad, B. G. — Towler, R. J.
Vandermillen, E. J.

Junior Grade

Students Eligible for Automatic Advancement

IOWA STATE COLLEGE

Albrecht, D. J. — Nielsen, R. L.
Hetzer, R. E. — Prey, A. J.
Kridelbaugh, L. E. — Smith, R. D.

Member Grade

Sutherland, C. F., Research Forester, USFS, St. Paul, Minn.; Univ. of Idaho, B.S.F., 1948. (Junior 1949).

Wisconsin-Michigan Section

Student Grade

MICHIGAN STATE UNIVERSITY

Blomquist, C. R. — Mann, W. K.
Coil, J. R. — March, G. O.
Grieves, P. C. — McCumber, J. E.
Schumann, R. H.

UNIVERSITY OF MICHIGAN

DeByle, N. V. — Rogers, J. W.
Henschel, E. G. — Schmae, M. O.
Jay, D. M. — Schumann, D. R.
Locke, E. N. — Stoltz, H. C.

Junior Grade

Clayton, R. L., Forester, City of Escanaba, Mich. (Reinstatement).

Clements, J. R., Research Asst., Univ. of Mich.; Univ. of Mich., B.S.F., 1957.

Erwin, R. L., Grad. St., Univ. of Mich.; Univ. of Mich., B.S.F., 1957.

Fitzpatrick, V. A., Forester Trainee, Dept. of Cons., Crystal Falls, Mich.; Mich. College of Mining & Tech., B.S.F., 1957.

Yankee, R. A., Forester, American Box Board Co., Filer City, Mich.; Mich. College of Mining & Tech., B.S.F., 1957.

Student Eligible for Automatic Advancement

MICHIGAN STATE UNIVERSITY

Thompson, H. R.

No Section

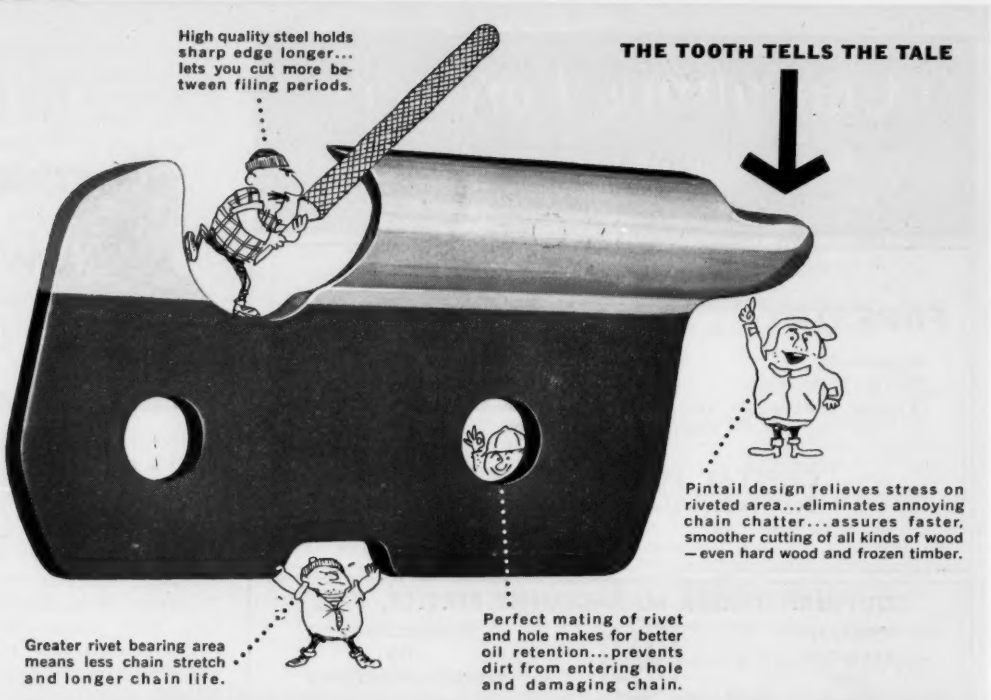
Affiliate Grade

Dearborn, J. P., Forester, Texas Petroleum Co., Bogota, Colombia.

Corresponding Grade

Cavere, A. S., Jefe de la Region Forestal de Pucallpa, Ministerio de Agricultura, Lima, Peru.

can den Ent, E. J., Grad. St., State Univ. of New York. Syracuse, N. Y.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Forestry News

AFA Elects Board of Directors

American Forestry Association has added a new member to its Board of Directors and re-elected five members for terms which began January 1.

Richard J. Preston, Jr., North Carolina, was elected for the first time. Re-elected were Stanley G. Fontanna, Michigan; Mrs. Katharine Jackson Lee, New Hampshire; Philip W. Smith, Pennsylvania; Harold B. Shepard, Massachusetts; and Henry T. McKnight, Virginia.

Those continuing on the board are Charles A. Connaughton, California; George L. Drake, Washington; Albert Ernest, Florida; Karl T. Frederick, New York; DeWitt Nelson, California; Edward P. Stamm, Oregon; James J. Storrow, New Hampshire; James C. Worthy, Illinois.

Armed Services Establish Conservation Programs

Plans are being made to assure that U. S. Air Force installations in the United States and Alaska are managed for maximum conservation of fish and wildlife. Elwood A. Seaman, former executive secretary, Sports Fishing Institute has been named advisor of the Air Force in this program, and commanders are being encouraged to seek technical advice and assistance from federal, state, and private agencies. Provision is being made for hunting and fishing by civilians on the land.

The Navy Department is establishing a similar program and plans better management of its lands for forestry purposes as well as for wildlife. Col. C. O. Totman of the Marine Corps, a professional forester, is advisor for the Navy's program.

National Wildlife Week Theme Announced

"Protect Our Public Lands" is the theme of National Wildlife Week,

March 16-22, 1958. Sponsored by the National Wildlife Federation, National Wildlife Week is designed to provide a nation-wide effort to further public interest in a conservation theme of current concern. This year the theme will stress the need for conserving public lands—parks and forests, wildlife and wilderness areas, and grazing and mineral lands.

National Forest Sanitation-Salvage Cut Protested

A proposed sanitation-salvage sale on the Los Padres National Forest, Calif., scheduled to be held December 2 was postponed pending action on a formal appeal to the chief of the Forest Service. The appeal was lodged against the cutting and removal of insect-infested timber by David R. Brower, executive director of the Sierra Club.

Billion Trees Planted in 1957

For the first time in history, the United States in 1957 planted a billion forest trees, according to the Department of Agriculture. To celebrate this achievement the tree selected to represent the billionth was planted December 18, at Macon, Ga.

This year's record exceeds by approximately 200 million trees the previous high set in 1956, according to a U. S. Forest Service compilation of reports from nurseries, state foresters, and federal agencies responsible for tree planting. The total includes all forest, soil bank conservation reserve, and windbreak tree planting by private landowners, industries, and public agencies.

This year's planting alone was reported to almost equal one half the total number of trees planted by the CCC between 1933 and 1942.

Eighty-six percent of the tree planting was on private lands and 14 percent on public lands. Twenty years ago only 26 percent was on private lands while 74 percent was on public land.

Governor Marvin Griffin of Georgia planted the billionth tree at ceremonies in Macon, December 18. Georgia was selected for the honor because its private landowners at the end of last year had planted more trees than those of any other state in the country.

Georgia at that time had planted 717,000 acres of privately owned land. Florida was second with 583,000 acres. Also high at the end of last year were Pennsylvania with 400,000 acres, New York with 462,000 acres, and Louisiana with 502,000 acres.

Forest History Group Sets Up Eastern Post

The Forest History Foundation, with headquarters in St. Paul, Minn., has established a regional office for eastern and southern United States and Canada, Dr. Theodore C. Blegen, president of the Foundation, has announced.

The field office will be located in Syracuse, N. Y., and Charles D. Bonsted has been appointed to the post effective January 1. Mr. Bonsted will assist Elwood R. Maunder, the Foundation's director, in field service to forest industries, historians, editors, archivists, and others seeking to assemble and use primary documents of forest use in the United States and Canada. He replaces Bruce C. Harding on the Foundation's staff. Mr. Harding recently accepted a position with the Ohio Historical Society, Columbus, Ohio.

Mr. Bonsted went from newspaper and magazine editing in 1948 to the faculty of the State University College of Forestry at Syracuse as technical and popular publications editor, press officer, and associate professor of forest extension. From 1953-1956 he managed the New York City news bureau of American Forest Products Industries, Inc.

Mr. Bonsted will represent the Forest History Foundation in the East and South from an office at 202 Landon Avenue, Syracuse, N. Y. He will organize and direct the work of coordinating regional committees of the Foundation set up to collect, preserve, and study records on the history of North American forests and forest-related groups.

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Forestry Historian Dies

Jenks Cameron, historian of American forestry, died November 23, 1957 in Cambridge, Mass., at the age of 78.

The Development of Governmental Forest Control in the United States was his major writing in forestry history. While he was with the Brookings Institute for Government Research in Washington, D. C. during the 1920's he wrote two monographs, *The National Park Service* and *The Bureau of Biological Survey*. His contributions to magazines include a series of articles in *American Forests* on the Santa Rosa Forest Nursery in Florida in 1828.

Mr. Cameron was born January 22, 1879, in Cecil County, Md. He received an A.B. degree from Johns Hopkins University in 1903, and later received a law degree.

Private & Industrial

To Advance Industrial Research

The appointment of Dr. Franklin C. Cech as research silviculturist and Kenneth F. Maxwell as forest manager at International Paper Company's Southlands Experiment Forest, Bainbridge, Ga., was announced in December by Dr. Charles H. Driver, director.

Dr. Cech is a graduate of Ohio University with advanced degrees from Montana State University and Texas A & M College. In working on his doctorate at Texas A & M in forest genetics and forest physiology, he had charge of the forest tree improvement program of the Texas Forest Service for two years. He will handle silvicultural research projects at Southlands.

Mr. Maxwell obtained his B. S. degree in forestry and a degree in soils at the University of Florida. In addition to being forest manager of the 15,000-acre Southlands Experiment Forest he will also carry out experimental work in forest management.

Celotex Appoints Manager of Forestry Division

Appointment of Lynn Sandberg as manager of The Celotex Corporation's Forestry Division has been announced by Henry W. Collins, president.

LYNN SANDBERG

Sandberg, who will headquarter at L'Anse, Mich., will be in charge of a forestry program for the Corporation's 242,000 acres of timber and timber land in the L'Anse area. The company has under construction there a plant for manufacture of fiberboard products.

Sandberg has been in forestry management since 1947, most recently operating his own timber producing and forestry consultant firm in Duluth, Minn. He is a forestry graduate of the University of Minnesota.

Celotex, manufacturer of a wide range of building products, purchased the Michigan tract in the spring of 1956 as part of a $22,000,000 company-wide plant expansion program. New plants are under construction or are already open at Pittston, Pa., Fort Dodge, Ia., and L'Anse.

Homelite Awards 4-H Scholarships

Homelite Corporation has recognized the work of four of the nation's 4-H Club members by awarding each a $1,600 scholarship to study forestry.

The winners, selected because their forestry projects were judged best in their respective 4-H extension districts and they show promise as future foresters, are: Charles W. Dismuke, Kilmichael, Miss.; Douglas Johnson, Braham, Minn.; Dan Pence, Mackay, Idaho; and Robert Paddock, Augusta, Wis.

Named to Scott Paper Post

Loren V. Forman has been appointed general manager of all Scott Paper Company's West Coast manufacturing and timber operations, it was announced in December.

Forman has been general manager of the Company's Everett, Wash. plant since 1956. A chemical engineering graduate of Iowa State College, Forman received his Ph.D. from The Institute of Paper Chemistry, Appleton, Wis.

He replaces Charles D. Dickey, Jr., who has been elected president of British Columbia Forest Products Ltd., Vancouver, B. C.

W. A. Johnson Is APA Forest Engineer

W. A. Johnson has been named forest engineer for the northeastern region of American Pulpwood Association, with headquarters in Portland, Maine. For the past ten years Mr. Johnson served as forester for the Brown Company.

He replaces H. M. Shepard, who recently accepted a position with Hiabob Hydraulics, Ely, Minn.

Education

OSC to Sponsor European Tour for Foresters

A six-week tour of industrial forestry operations in seven European countries will be sponsored next summer by the Oregon State College School of Forestry to give American forestry leaders an opportunity to observe and discuss the intensive forestry methods now employed in Europe.

Countries to be visited are Norway, Sweden, Denmark, Germany, Austria, Switzerland, and France.

The tour will start in Portland, May 23, 1958. J. R. Dilworth, head of the OSC Forest Management Department, will be tour director. The group will fly to New York and then to Oslo, Norway, to begin the series of forest and plant visits and conferences.

Present plans are to limit the party to about 35 persons, Dilworth said. Leading European foresters will be guides and consultants in the various countries to be visited and foreign forestry associations are cooperating in an effort to make the tour of maximum benefit.

Costs to the individuals making the trip have not yet been set since some travel arrangements are still to be made. Detailed information can be secured from the OSC school of forestry for persons interested.

The tour was arranged as a continuation of the series of short courses sponsored by OSC as a service to the forest industry, Dilworth noted. Other short courses have included instruction in use of aerial photographs, variable plot cruising, genetics, forest road location, forest pests, and forest products.

In Sweden. Dr. Thorsten Streyffert, director of the Royal College of Forestry, Stockholm. will be chairman of the conference. Dr. Fritz Fischer, University of Zurich, will be chairman in Switzerland and Dr. Peter Burschel, University of Gottingen, in Germany.

LSU to Hold Seventh Forestry Symposium

The Seventh Annual Forestry Symposium sponsored by the Louisiana State University School of Forestry will be held April 10 and 11, 1958, according to Charles B. Briscoe, assistant professor of forestry, who will be general chairman of the symposium.

Theme of the program will be "Management of Bottomland Forests." Two half-day sessions will be held April 10, with a third session slated the following morning.

Sessions will consist primarily of panel discussions and the reading of papers. Forestry specialists from all over the eastern portion of the United States have been invited to appear on the program.

The place of bottomland forests in Southern forestry, regeneration, and genetic possibilities will be discussed at the opening session. The panel on regeneration will consider subjects such as direct seeding of cherrybark oak, planting cuttings of cottonwood, planting seedlings of baldcypress, and natural regeneration following selective cutting and seed-tree cutting.

Thinnings, cull removal, and commercial improvement cuttings will be discussed in the afternoon session. A panel on thinnings will give particular attention to cottonwood, willow, sweetgum, water oak, and bald cypress.

During the second morning session, on the subject of utilization, a panel on pulp will present views on pulpwood logging, effects of pulpwood on sawlog-veneer management, and the future of the portable chipper.

Inquiries about the symposium may be addressed to Professor Charles B. Briscoe, LSU School of Forestry, Baton Rouge 3, Louisiana.

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Named To Iowa Staff

Irving Holland joined the Iowa State College staff in November 1957 as an assistant professor in the Forestry Department.

Holland received his Bachelor of Science degree in forestry from the University of California in 1940. He earned his Ph.D. from the same institution in 1952.

In 1941, he was a forestry aide in Woodland, Colo. and a junior forester in Berkeley, Calif. From 1952 to February 1946, he served with the U. S. Army. From 1946 to May 1949, he served as junior forester in Berkeley, Calif., and from 1949 to 1952, he was a graduate student in Berkeley. For the past five years he was a forest economist in Washington, D. C.

Holland is a member of Xi Sigma Pi forestry honorary and held the Baker fellowship in forestry at the University of California.

SHOWN ABOVE are four Penn State forestry students who were awarded scholarships this fall. *Left* to *right*, Carl W. Wolfe, a senior in general forestry, and Robert J. Ward, a senior wood utilization major, recipients of the Homelite Award; Kerry F. Schell, a senior in forest management, and Robert M. Carey, a junior majoring in general forestry, recipients of the Glatfelter Award.

Industrial Forestry Seminar Scheduled at University of California

The second West Coast Industrial Forestry Seminar, offering advanced training and discussion for executives in forest products industries will be held March 24 through April 4 at the University of California, Berkeley. Presented by the School of Forestry, University of California, in cooperation with Yale University's School of Forestry, and University of California Extension, the two-week seminar will deal with current problems in the management of these industries.

General topics to be discussed include economic trends in forest industries, particularly on the West Coast, current income tax and general property tax problems in the industry, forest planting, wood product research and development, labor problems, and public relations. E.T.F. Wohlenberg, professor of forestry, Yale University, will direct the seminar.

Among the seminar leaders will be J. A. Zivnuska, associate professor of forestry, University of California; Paul Olson, tax specialist for Crown Zellerbach Corporation; J. W. Duffield, forest geneticist and director of the William B. Greeley Nursery; and C. C. Heritage, consultant.

Enrollment is limited to 20, and a fee of $200 for the two work weeks will be charged each applicant. Further information may be obtained by contacting Dean H. J. Vaux, School of Forestry, University of California, Berkeley 4, Calif.

Willem Prins Joins Staff of Research Institute

Dr. Willem Prins has been appointed research associate with the Cellulose Research Institute at State University College of Forestry at Syracuse University, according to an announcement by Dr. E. C. Jahn, associate dean for physical sciences and research at the College.

Dr. Prins goes to Syracuse from Cornell University, where for the past two years he did research on the behavior of non-ionic detergents in non-aqueous solvents.

He was educated in Holland, taking his undergraduate work at the University of Groningen and his Ph.D. at the University of Leiden. He has had several papers published dealing with light scattering by solutions and by liquids and with other basic physical chemical phenomena. At the Cellulose Research Institute, Dr. Prins will study the physical chemistry of cellulose.

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Holds Montana Extension Post

Richard T. Marks has been appointed forester for the Montana Extension Service at Montana State College at Bozeman, and is now working with Montana farmers and ranchers on shelterbelts, windbreaks, and woodlot management.

Before his appointment Marks had served since 1954 as district forester for the Montana State Forestry Department with headquarters at Bozeman.

A native of Minnesota, Marks studied at the University of Minnesota and then attended the School of Forestry at Montana State University, Missoula, graduating in 1953.

Four are Scholarship Winners

Two University of Minnesota forestry seniors have received $250 each in scholarships from Homelite Corporation. They are Carl Reidel and Richard Schneider.

At the University of North Carolina similar awards were made to Jack Sturgill and Edward Barden.

Recipients were chosen for their academic aptitude, vocation promise, leadership qualities, and financial need.

Michigan State Schedules Lumber Grading Course

On March 3-7, the second annual Hardwood Lumber Grading Course will be held at Kellogg Center for Continuing Education, on the campus of Michigan State University at East Lansing.

Two days will be devoted to the study, explanation, and application of grading rules; three days will be devoted to actual grading by small groups in the classroom, and individual grading at another location.

Public

Pacific Northwest Personnel Promoted

Promotions of George H. Jackson, James B. Lowrie, and Newland A. Kissinger, Jr. have been announced by Regional Forester J. Herbert Stone, Pacific Northwest Region, U. S. Forest Service.

Lowrie, a staff officer in the region's Timber Management Division, has been engaged in mill-scale and end-product recovery studies and the training of personnel in grading and log scaling. He has been appointed to a Washington Office field position in which he will expand similar work to cover all western regions of the Forest Service. His headquarters will remain at Portland.

James B. Lowrie will assume Jackson's regional staff duties. He goes to his new post from the staff of the Snoqualmie National Forest.

Neland A. Kissinger, Jr. has been named to a position in the Region's Division of Personnel Management from that of a district ranger on the Malheur National Forest.

Wildlife Specialist Joins Intermountain Staff

Robert L. Casebeer of Boise, Idaho, has been appointed to the staff of Intermountain Forest and Range Experiment Station as range conservationist, according to an announcement by Reed W. Bailey, director. He will be stationed at Boise to work as a member of the Boise Research Center staff.

Mr. Casebeer has for the past several years been working with the Idaho Fish and Game Department. He is a graduate of Montana State University College of Forestry, and holds the master's degree in forestry. He has worked for the fish and game departments of Montana and Idaho, and prior to the war, for both the U. S. Forest Service and the U. S. Fish and Wildlife Service.

Intermountain Region Promotions Announced

Gilbert S. Doll, supervisor of the Ashley National Forest, Vernal, Utah, has moved to Ogden, Utah as an assistant chief of the Water, Recreation, and Lands Division, Intermountain Region of the U. S. Forest Service, according to Floyd Iverson, regional forester.

Andrew R. McConkie, assistant supervisor of the Bridger National Forest, Wyoming, will be the new supervisor of the Ashley National Forest.

The transfers and promotions became effective January 26.

A native of Colorado, Mr. Doll received his B.S. and M.S. degrees in forestry at the University of Idaho and did extension forestry work both in Idaho and Nevada before entering the Forest Service on the Toiyabe National Forest as assistant ranger in 1943. He became assistant supervisor on the Toiyabe National Forest in 1952 and was promoted to supervisor of the Ashley National Forest in 1955.

McConkie received his B.S. degree in forestry from Utah State University in 1935. He served as junior forester on the Bridger National Forest until 1937 when he was appointed forest ranger on the Salmon National Forest. He was forest ranger on the Uinta National Forest at Heber, Utah

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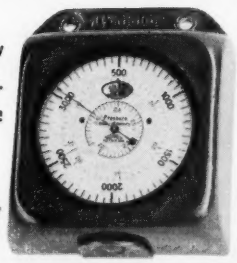

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from 1944 until his promotion to assistant supervisor of the Bridger National Forest in 1955.

H. P. Brandner Retires

Retirement of H. Phil Brandner, Pacific Northwest Region, has been staff officer in the Division of Operation of the U. S. Forest Service, announced by Regional Forester J. Herbert Stone. The retirement was effective December 31. For the past 4 years Brandner has been in charge of special studies. Before that for 9 years he was forest supervisor of the Mt. Baker National Forest in northern Washington.

Mr. Brandner began his Forest Service career with seasonal work in 1927 and was appointed as ranger in 1929. He held various positions in the Pacific Northwest and in the Northeast until in 1943 he was transferred and promoted to forest supervisor of the Alabama National Forest at Montgomery, Ala. He again returned to the Pacific Northwest Region to the Division of State and Private Forestry in 1944. It was later that year that he became forest supervisor of Mt. Baker National Forest.

A native of Wisconsin, Brandner received his Master of Forestry degree from the University of Washington in 1930. He was in the military service in World War I in the U. S. Navy.

Allied

Florida Forestry Council Meets

The Florida Forestry Council held its annual meeting in Tallahassee, Fla., December 2. The program included a panel discussion under the leadership of Donald D. Stevenson, research forester with the Buckeye Cellulose Corp., entitled "Florida Forests and What to Do About Them."

The Council has decided to undertake a study of (1) forests and game, (2) forests and recreation, and (3) forests and water, the results of which will be published in a brochure for the reference of state officials and lawmakers.

Officers for 1958 are: Chairman—Dr. C. M. Kaufman, School of Forestry, University of Florida; Vice-Chairman—Julius Stern, Southern Hardwood Plywood Corp.; and re-elected as Secretary-Treasurer—Charles G. Geltz, School of Forestry.

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

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Forester, B.S., Pennsylvania State University, 1951. Age 28, married, veteran. Experience includes timber management planning, cruising, timber sales administration, scaling, cartography, and some fire control with state organization and Forest Service. Desires timber management position with private industry in Northeast or Middle Atlantic states.
Box A, Journal of Forestry, Mills Building, Washington 6, D. C.

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